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## CIVIL ENGINEERING.

*On Wooden Railways. By* Mr. W. Bridges.

The lecturer commenced by adverting to the fact, that lines of railway were now extended southward to Brighton and Southampton, westward to Exeter, north-west to Birmingham and Liverpool, east and north-east to Norwich and Ipswich—while the city of York, the port of Hull, and all the towns on the direct north route, were left to find a circuitous approach to the metropolis. He, however, contended that although occasion of surprise, this was hardly matter for regret, inasmuch as new science, and new systems might now guarantee the construction of a railway from York to London, at a fourth, or fifth, of the cost ten, or twelve, years ago. Amongst these new systems, the most valuable was the proposed recurrence by Mr. W. Prosser, with certain striking modifications, to the ancient wooden railway. These modifications were—1. The chemical transmutation of the fibre of the wood into a more durable, hard, and almost incorruptible, substance. 2. The employment of a beveled guide wheel, fixed at an oblique angle before and behind each carriage, as a substitute for the flanch, which is the main cause of the wear and tear on the existing railways. By means of this guide wheel, the bearing and carriage wheels would be quite flat, obviating all abrasion of the wood, as well as all liability to oscillation. Under such circumstances, each wheel is permitted to act independently, as with the wheels of an ordinary carriage, and the carriage would be placed upon the ordinary carriage springs. Mr. Adams, the great coach builder, was strongly impressed with the value of the proposed modification, and anticipated, from the use of such carriages, that railway traveling might be

henceforth perfectly smooth and noiseless. The process by which the wood is chemically transmuted is the injection of two salts, alkaline and metallic, (known by the name of Paynizing,) which salts, by decomposition, produce an insoluble matter of the timber, arresting and destroying the vegetable principle—so to speak, fossilizing the wood. It was to be noted, that the wood tram was not a novelty—that Mr. Prosser's invention was undeniably a recurrence to the "wisdom of our ancestors," but under such peculiar modifications as made such recurrence eminently desirable, as a means of obviating the incalculable inconveniences and expense of the present mode of railway construction. The first step in this, the right, direction was, the adoption of longitudinal sleepers on the Great Western Railway, and that experiment had been eminently successful—the Great Western, with all its wear and tear, and other evils common to all iron railways, being the best railway yet constructed in Europe. The rails, then, or rather trams, are indurated by the process of Paynization, and are laid down on the principle of the old tram roads, let into wooden sleepers, and secured therein by wedges, forming one great frame of longitudinal and cross sleepers on the leveled surface of the ground. The tires of the wheels being perfectly flat, are kept in the even tenor of their way by two guide wheels before and behind each carriage, fixed at an angle of 45° to the horizontal line; two tires, in their circumference at right angles to one another, embrace the upper and inner edge of the tram. All the wheels being on separate axles, the inner and outer wheels adapt themselves with safety and facility to the sharpest curves. The great advantage of wood over iron, presuming its durability to be secured, is, the adherence of its surface involving about double the tractive power of iron. Much fallacy existed on this subject, and this very adhesion was often alleged as a reason against the adoption of the proposed system; the objection was based on a confusion of friction and adhesion. The driving wheels of the engine are pressed to the rail by a certain weight—say that of the engine itself—and this pressure produces between the wheel and the rail a certain amount of adhesion; upon iron railways this weight is necessarily increased in an inordinate degree, to counterbalance the want of adhesiveness of surface. If the engine were prevented from moving forwards by some immovable obstacle, and were also powerful enough to overcome this adhesion, the wheels of the engine would revolve, although the carriage made no progress; if the obstacle were diminished, so that it will give way before the adhesion is overcome, the engine advances. The magnitude of this obstacle, which is thus capable of being removed, is to be measured by the amount of adhesion—for, if its resistance be greater than that adhesion, the obstacle will not be removed. The total amount of resistance to progress on a railway is correctly represented by such an obstacle; and there is an amount of train which an engine of a given weight will not draw, whatever its power, for its wheels will rather revolve than draw the train. This adhesion, and, therefore, the source of tractive power, is double with an iron wheel on a wood surface, than on a surface of iron. In ascending a gradient, the engine has not only to draw, but to lift; if the adhesion, or bite, be

small, the engine must be preposterously large, to draw the train on the level portions of the line; increase this bite, or adhesion, and you may increase the steepness of the gradients, and diminish the weight of your carriage. This immense saving may be made in cuttings and embankments, as well as in the carrying establishment, and in the locomotive power. The truth is, that since the era when it was universally received that the periphery of a wheel could never act as a propulsive fulcrum, engineering science has only been gradually awaking to the immense importance of this one principle of adhesion; and the establishment of sound views here must lead to the universal adoption of wooden railways. A striking proof of the durability of Paynized wood was afforded in the fact, that a tram had been laid down at Messrs. Dalton's wharf, at Vauxhall, on the 15th of August, 1843, and the quantity of coals and other goods that had passed over it up to the 1st of May last, was 37,000 tons, without producing any perceptible effect upon its surface. Prepared beech had recovered the deflection of three-eighths of an inch, resulting from a pressure of 140 tons on the tire of a wheel; and on an experimental tramway the carriages had passed over a number of times, (28,000) equal to a year's traffic on an ordinary railway without obliterating the saw marks.—Mr. Bridges submitted various calculations, to exhibit the probable economy of the process, the result of which is, with respect to superstructure, that a double line might be laid down for about 1700*l.* per mile, instead of from 3500*l.* to 4000*l.*, the actual cost of iron rails. Mr. Vignoles had assumed, that by taking gradients of 1 in 230, instead of 1 in 330, on the Irish south lines, the cost of railways in that country might be reduced from his first estimate of 13,000*l.* to 11,000*l.* per mile. A still wider range of choice, both as to gradients and curves, would be afforded by the adhesive principle of a wooden line, now advocated; and the probable total cost of an Irish line, including earth works, masonry, fencing, land, upper works, carrying establishment, parliamentary expenses, and contingencies, would not exceed 6000*l.*—and, by making use of Scotch fir, instead of beech, (and the greater porosity of the former timber renders it more susceptible of the chemical action,) probably not 5000*l.* per mile. As an important aid to the construction of wooden railways across the soft and boggy districts of Ireland, Mr. Bridges shortly adverted to the very simple and philosophical pile sinking apparatus of Dr. Potts, which substitutes pneumatic power for manual labor and the 'monkey.' Dr. Potts employs hollow tubes of iron, or Paynized wood; the lower extremity is open, and to the upper extremity is affixed an air-tight cap, with a flexible tube of jointed metal, or elastic hose, extending to a receiver, from which the air is extracted by suction; when the air within the tube is thus exhausted, the mud and shingle flow into the tube, which then rapidly descends by its own weight, and the pressure of the external atmosphere. Finally, the importance of the introduction of economical railways into Ireland at this moment were held to be of more consequence than any which legislation, either of Parliament, or a Federal Convocation, or a Repeal Congress, can possibly effect—by giving employment to the population of that country,

by developing her vast yet hidden resources, by opening markets for her produce, by uniting her more closely with other countries, and by increasing the happiness and comfort of her inhabitants. An animated discussion ensued.

Mr. Fairbairn observed, that one hundred and fifty years ago wooden railways had been very general over a great part of the north of England, but that the expense of repairs had set invention to work to discover new modes, and this search had resulted in the present system of iron superstructure. There could be no doubt, however, that by such a system as the present the prime cause of the destructibility of the wooden trams might be removed, and, in that case, wooden railways might be re-established with advantages. The invention exhibited by Mr. Bridges, seemed very good and ingenious.

Dr. Scoresby, in commenting on the subject, gave a very interesting account of the working of wooden railways in America, which, from the simple and unornamental character of the works of art, and other causes, were certainly very economical. The desideratum was such a guide wheel as that of Mr. Prosser, which he hoped would now attract attention and investigation.

Dr. Greene characterized the invention as exceedingly beautiful and simple, and illustrated the safety principle of the guide wheel by a diagram, showing that the centre of motion had actually to describe an arc of 45° before the train could be in even the same liability to yield to the centrifugal influence as the present railway train in its natural position. Indeed, he considered the action of this oblique wheel to be totally different in character and rationale from the ordinary flanch.

Inquiries were put to the lecturer as to the different susceptibility of different kinds of timber to become indurated by Paynization.—Mr. Bridges stated that the harder woods, such as oak and *lignum vitæ*, would hardly be benefited by the process, which acted with most effect upon the more porous woods; indeed, he held it to be a sufficient advantage to make Scotch fir equal to oak, without professing to transmute oak, or *lignum vitæ*, into iron.

The President briefly explained the chemical action of the two solutions injected into the wood, resulting in the formation of gypsum, or plaster of paris, within its pores.

Dr. Scoresby gave a detail of experiments he had made to test the effect of salt water under high pressure upon different kinds of timber. He had placed pieces of fir, cork, oak, &c., at such a depth in the sea as to sustain a pressure of eight tons to the inch, and the result was, that every piece of wood became of exactly the same density.

Prof. Byrne suggested that the fibres of the wood should, by means of blocks, be placed vertically, instead of horizontally, to insure greater durability.

Mr. Roberts, admitting that he had not come in until after the lecture was delivered, expressed scepticism as to the value of wood as a superstructure; but the chairman notified to him that certain chemical and mechanical means were employed to harden the wood, and to protect it from abrasion.

Mr. Fairbairn only feared that the weight of the ordinary engine (fifteen tons) would be an obstacle to the realization of all the advantages contended for by Mr. Bridges; but Mr. Bridges, in final reply, opposed to this the affirmation of Mr. Adams, that the weight could be greatly reduced. Moreover, a comparison of even weight with weight was inadmissible here, inasmuch as smooth tires and avoidance of oscillation, would, in themselves, have been a counterbalance even to an increase of weight.—The lecturer briefly returned thanks to the section for their reception of the subject—and, on the suggestion of the chairman, the thanks of the section were voted to Mr. Bridges for his communication.—*(Proc. British Assoc., Sept* 28.)

Lond. Min. Journ.

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*Problems on Steam Power. By* Mr. Thomas Tate, *Mathematical Master of the Normal School, Battersea.*

Hitherto the investigations have been conducted on purely algebraic principles, but in discussing the following interesting problems, it will be necessary to call in the aid of the integral calculus.

36. To find the relation between the space and velocity of a locomotive, after the steam has been turned off, taking the resistance of the air into account.

By differentiating equation (47) page 72, of Moseley's Mechanical Principles of Engineering, we find,

$$dS = \frac{W}{g} \cdot \frac{V dV}{P} \quad \ldots (1);$$

where V is the velocity in feet per second, corresponding to the space $s$ feet, (estimated from the point at which the steam is turned off,) and P the unbalanced, or moving, pressure at that point,

$$\text{By eq. (1), 26, } R = T\,(r + 22.4h) + \frac{q}{V_1^2} \cdot V^2 = a + bV^2.$$

In this case the unbalanced pressure is an opposing force, and, therefore, it must be taken minus in the general expression (1),

$$\therefore dS = -\frac{W}{g} \cdot \frac{V dV}{a + bV^2}.$$

Integrating between the limits $v$ and V, we have

$$S = \frac{W}{2gb} \log. \frac{a + bv^2}{a + bV^2} \cdots (2).$$

In performing this integration, it will be observed, that when $S = o$, $V = v$.

When $V = o$, that is, when the train comes to a state of rest, the equation becomes,

$$S = \frac{W}{2gb} \log. \left(1 + \frac{b}{a} \cdot v^2\right) \ldots (3).$$

In order to obtain V in terms of S, let $\frac{W}{2gb} = \frac{1}{c}$; then by the pro-

perties of logarithms, $e^{-cS} = \frac{a+bV^2}{a+bv^2}$, whence we finally find,

$$V = \left(\frac{(a+bv^2)\,e^{-cS}}{b} - \frac{a}{b}\right)^{\frac{1}{2}} \ldots (4.)$$

**Example 46.** The weight of the train, in example 43, is 100 tons, it is required to determine the distance the train will move after the steam is turned off, assuming the resistance of the air to be the same as in example 28.

Here $a = 100\,(8 + 22.5 \times .5) = 1925$, $b = .33$, $W = 224000$, and $v = 44$, therefore, by eq. (3,)

$$S = \frac{224000}{2 \times 32 \times .33} \log.\left(1 + \frac{.33}{1925} \times 44^2\right) = 3024 \text{ feet nearly.}$$

**Observation.** Comparing this result with that of Example 43, it appears that 500 feet are due to the resistance of the atmosphere.

37. To determine the relation between S and V, assuming the pressure upon the piston to be constant, as in the atmospheric locomotive.

Let $R_1$ be the total pressure of the elastic fluid referred to the circumference of the wheel, then, as the opposing pressure is given in eq. (2,) 36 we have $P = R_1 - R \times R_1 - a - bV^2 = c - bV^2 \ldots (1,)$ substituting this value of the accelerating pressure in eq. (1,) 36, and integrating as before, we obtain,

$$S = \frac{W}{2gb} \log. \frac{c - bv^2}{c - bV^2} \ldots (2.)$$

Here $v$ is the velocity with which the engine starts. When the engine attains a maximum speed the accelerating force must be nothing, that is, we must have $c - bV^2 = 0$, or $V = \sqrt{\frac{c}{b}}$; but when this takes place, the denominator of the logarithm becomes nothing, and then $S = \infty$. Hence it appears that the train never does attain its maximum speed, as that can only take place when the space moved over is infinite.

**Example 47.** Through what space will the engine, in the last example, have to move in order to acquire the speed of 30 miles per hour, supposing the pressure of the elastic fluid upon the wheel to be 4000 lbs., and that the engine starts with the velocity of 10 feet per second?

Here $c = 4000 - 1925 = 2075$, $b = .33$, $W = 224000$, $V = 44$, and $v = 10$; then, by eq. (2,)

$$S = \frac{224000}{2 \times 32 \times .33} \log. \frac{2075 - 33}{2075 - 638.8} = 3720 \text{ feet.}$$

38. To determine the relation of $t$ and V, when the elastic fluid acts as in the last problem.

For this purpose we have the general equation,

$$P = \frac{W}{g} \cdot \frac{dV}{dt}.$$

(Moseley's Mechanical Principles of Engineering, p. 94,) therefore, by eq. (1,) 37, we have,

$$c - b\,V^2 = \frac{W}{g}\cdot\frac{d\,V}{d\,t};$$

$$\therefore t = \frac{W}{g}\int_V^v \frac{dV}{Vc - bV^2} = \frac{W}{2\,g\,c^{\frac{1}{2}}\,b^{\frac{1}{2}}}\log.\frac{(c^{\frac{1}{2}} + b^{\frac{1}{2}}V)(c^{\frac{1}{2}} - b^{\frac{1}{2}}v)}{(c^{\frac{1}{2}} - b^{\frac{1}{2}}V)(c^{\frac{1}{2}} + b^{\frac{1}{2}}v)};$$

where $v$ is the initial velocity, or what V becomes when $t = 0$.

When the engine attains its maximum speed, $V = \sqrt{\frac{c}{b}}$; but in this case the factor $c^{\frac{1}{2}} - b^{\frac{1}{2}}V = 0$, and then the expression for $t$ becomes infinite, thus confirming the deduction made in 37.

Example 48. In what time will the engine, in example 47, attain the speed of 30 miles per hour?

Here,

$$t = \frac{224000}{64 \times .574 \times 45.5}\log.\frac{(45.5 + .574 \times 44)(45.5 - .574 \times 10)}{(45.5 - .574 \times 44)(45.5 + .574 \times 10)} = 2.2 \text{ min.}$$

39. To determine the relation between S and V, when the pressure of the steam in the cylinder is a given function of the velocity.

Let the total effective pressure of the steam upon the driving wheel be expressed by the equation $R_1 = f(V,)$ then, by eq. (1,) 37,

$$P = f(V) - a - bV^2;$$

$$\therefore S = \frac{W}{g}\int_V^v \frac{V\,dV}{f(V) - a - b\,V^2} \quad \ldots (1.)$$

If, therefore, $f\,V$ were known, the integration might be effected; but, independently of experiment, it is impossible to discover any exact analytical representation of this function; for, amongst other circumstances of less complexity, it evidently depends upon the variable discharge of the steam into the cylinder, arising from the unequable motion of the piston in each stroke, and the consequent change of temperature and density of the steam. If, however, the relation of the mean pressure and velocity were determined by experiment in three, or more, cases, the law of relation might be ascertained sufficiently near, for practical purposes, by the method of interpolation. In the absence of such data, an approximation to the truth will be obtained, by supposing the pressure to be inversely as the velocity, or what is the same thing, by assuming the working power of the engine to remain constant. Proceeding on this hypothesis, let U be the work of the engine per second, then $R_1 \times V = U$; and $\therefore R_1$, or $f\,V = \frac{U}{V}$, substituting in equation (1,)

$$S = \frac{W}{g}\int_V^v \frac{V^2\,dV}{U - a\,V - b\,V^3} \quad \ldots (2.)$$

Integrating this expression, between the limits $v$ and V, first when the resistance of the atmosphere is neglected, we find,

$$S = \frac{W}{g\,a}\left\{\tfrac{1}{2}(v^2 - V^2) + \frac{U}{a}(v - V) + \frac{V^2}{a^2}\log.\frac{U - a\,v}{U - a\,V}\right\} \quad \ldots\ldots (3.)$$

In order to integrate the general formula, it is necessary to observe that, since U, $a$, and $b$ are essentially positive, when the engine ascends the incline, the expression in the denominator will have one positive and two imaginary roots, (see Hymer's Equations, p. 82.) Let $e$, therefore, be the real root, then,

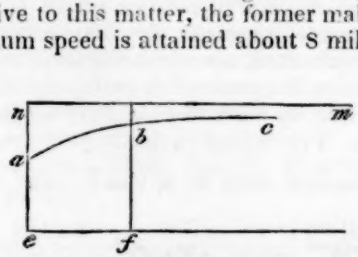
$$S=\frac{W}{g}\int\frac{V^2\,dV}{U-aV-bV^3}+C=\frac{-W}{g\,b}\int\frac{V\,dV}{V+\frac{a}{b}V-\frac{U}{b}}+C=$$

$$\frac{-W}{g\,b}\int\left\{\frac{D\,dV}{V-e}+\frac{(AV+B)dV}{(V-a)^2+\beta^2}\right\}+C=$$

$$\frac{W}{g\,b}\left\{D\log.\frac{v-e}{V-e}+\frac{A}{2}\log.\frac{(v-a)^2+\beta^2}{(V-a)^2+\beta^2}+\frac{Aa+B}{\beta}\left(\tan.^{-1}\frac{v-a}{\beta}-\tan.^{-1}\frac{V-a}{\beta}\right)\right\}\quad(4.)$$

When the motion of the train becomes uniform, $V^3+\frac{a}{b}V-\frac{U}{b}=0$, the real root of which is $e$. By putting this value for V in the above expression, the term $\log.\frac{v-e}{V-e}$ becomes infinite. Hence it appears that the maximum speed of the engine cannot be attained until it has gone over an infinite distance.

Applying the same reasoning to equation (3,) we have for the equation of uniform motion, or maximum speed, $V=\frac{U}{a}$, and for this case $S=\infty$. The assumption $fV=\frac{U}{V}$, upon which this remarkable result has been based, evidently gives the moving pressure rather below what in ordinary cases it really is; therefore, *à fortiori*, our locomotive engines never do attain their maximum speed. At the same time it is important to observe that our expression indicates that the speed undergoes but little increase after it has attained a certain limit. This analytical deduction will account for the discrepancies in the statements of two of our most distinguished engineers, Brunel and Stephenson, relative to this matter, the former making the distance at which the maximum speed is attained about 8 miles, the latter only about 4 miles.




The relation of speed and space may be represented by the approach of a curve $a$, $b$, $c$, towards its asymtote $n$, $m$, where $b$, $f$, is the velocity corresponding to the space $e$, $f$, moved over, and $e$, $n$, the maximum; requiring the engine to move over an infinite distance to attain that speed, but showing at the same time that this maximum speed is ***nearly*** attained in a finite time.

Example 49. When will an engine of 60 horses power attain a speed of 30 feet per second, or about 20 miles per hour, the weight of the train being 50 tons, the resistance of friction 8 lbs. per ton, and the velocity of starting 10 feet per second?

In this case, $U = \frac{60 \times 33000}{60} = 33000$; $v = 10$; $V = 30$; $a = 50 \times 8 = 400$; $W = 50 \times 2240$; $g = 32$; then, by eq. (3,)

$$S = \frac{50 \times 2240}{32 \times 400} \left\{ \tfrac{1}{2}(10^2 - 30^2) + \frac{33000}{400}(10 - 30) + \frac{33000^2}{400^2} \log. 1.38 \right\} =$$

1240 feet.

Example 50. Through what space will the engine in the last example have to move in order to attain the speed of 70 feet per second, or 47 miles per hour?

$$\text{Here } S = \frac{35}{4} \left\{ -2400 - 4950 + 6806.25 \times \log. 5.8 \right\} = 7.6 \text{ miles.}$$

Example 51. When will the engine in the last example attain the speed of 60 feet per second, or 41 miles per hour?

Proceeding, as in the last example, we find $S = 3.7$ miles.

40. To determine the relation between $t$ and V, supposing the steam to act as in the preceding problem.

When the resistance of the atmosphere is neglected, we have $P = \frac{U}{V} - a$; therefore, by substitution in the general formula 38,

$$dt = \frac{W}{g} \cdot \frac{dV}{\frac{U}{V} - a} = \frac{W}{g} \cdot \frac{V\,dV}{U - aV} = \frac{W}{g} \left\{ -\frac{dV}{a} + \frac{U}{a} \cdot \frac{dV}{U - aV} \right\}$$

Integrating between the limits of V and $v$,

$$t = \frac{W}{ag} \left\{ v - V + \frac{U}{a} \log. \frac{U - av}{U - aV} \right\}$$

and so on to the general case.

Here again we observe, that when the speed is a maximum the time is infinite.

Example 52. In what time will the engine, in example 49, acquire the speed of 60 feet per second?

$$\text{Here, } t = \frac{50 \times 2240}{400 \times 32} \left\{ 10 - 60 + \frac{33000}{408} \log. 3.22 \right\} = 6.7 \text{ minutes.}$$

41. Having introduced the use of a more recondite analysis, it may be interesting to apply the same method to the investigation of the Problems, 2, 7, and 8.

If $l$ be the whole stroke, including the clearance $c$, $U_1$ the work done expansively at $x$ feet of the stroke, corresponding to $P_1$ pressure of the steam, then by Moseley's Mechanical Principles, (page 55,)

$$U_1 = \int_x^h P_1\,dx \ldots (1.)$$

By the formula of relation between the volume and pressure of the steam, (page 102, vol. xl.)

$$P_1 = \frac{1}{\frac{x}{h}\left(\frac{1}{P} + .00268\right) - .00268} = \frac{1}{ax - b};$$

where $a = \frac{1}{h}\left(\frac{1}{P} + .00268\right)$; and $b = .00268$.

Substituting this value of $P_1$ in eq. (1,) we have,

$$U_1 = \int_x^h \frac{dx}{ax - b} = \frac{1}{a} \log. \frac{ax - b}{ah - b} \ldots (2.)$$

To determine $x$ in terms of $U_1$, we find from the properties of logarithms,

$$e^{aU_1} = \frac{ax - b}{ah - b}, \therefore x = \frac{1}{a}\left\{(ah - b)e^{aU_1} + b\right\} \ldots (3.)$$

When $x = l$ in equation (2,) the whole work in one stroke becomes,

$$K U \text{ or } L K(l - c) = K\left\{\frac{1}{a} \log. \frac{al - b}{ah - b} + P(h - c) - p(l - c)\right\} \ldots (4.)$$

Where L represents the sum of the pressures opposing the motion of the piston, as in eq. (A,) 10.

When the work is required in terms of the water evaporated, the P, in this expression must be eliminated, by the expression given in 14.

Substituting the values of $U_1$ and $U_2$ in the expression given in 7, we find,

$$V = \left\{\frac{2gK}{W}\left(\frac{1}{a} \log. \frac{ax - b}{ah - b} + P(h - c) - p(x - c) - Lx\right)\right\}^{\frac{1}{2}} \ldots (5.)$$

If R be put for the sum of all the resistances upon each inch of the piston, viz., $F + L_1(1 + f) + p$, then the maximum velocity will take place when, $P_1 = R = \frac{1}{ax - b}$; from which we find,

$$x = \frac{1}{Ra}(1 + bR) \ldots (6.)$$

This is the expression for the position of the piston, when the maximum velocity takes place; it is more accurate than that given in 8, inasmuch as Pole's formula gives the relation of the volume and pressure of the steam more accurately than Marriotte's law. It may not be improper here to observe, that the expression given for this point in the paragraph just referred to, neglects the pressure of the vapor in the condenser.

Example 52. Required the work performed upon 1 inch of the piston, in example 1.

Here,

$P = 28$, $l = 9$, $h = 3$, $c = 0$, $K = 1$, then by for. (4,) $a = \frac{1}{3}\left(\frac{1}{28} + .00268\right) =$ .01279, $b = .00268$, and $U = \frac{1}{.01279} \log. \frac{.01279 \times 9 - .00268}{.01279 \times 3 - .00268} + 28 \times 3 = 174.$

It will be observed that this result nearly coincides with that obtained in example 1.

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## FRANKLIN INSTITUTE.

*Extracts from the Reports of the Judges appointed to examine the Articles offered at the Fourteenth Exhibition of American Manufactures; held October,* 1844.

(Continued from Page 169.)

The Committee of Judges on Hardware were highly gratified in entering upon the duties of their appointment to notice the general improvement in the hardware exhibited this season, particularly in cast-iron and hollow ware. In their investigations they have examined every specimen enumerated in the catalogue furnished them by the Actuary. In consequence of the number of articles submitted to them, their remarks must necessarily be brief: the first article is—

No. 1001, one case of samples gilt buttons, made by Wadham, Webster & Co., Wolcottville, Conn., deposited by makers. These are a beautiful article, elegantly finished, but in no respects superior to those exhibited at the last exhibition. In some of the specimens there is room for better taste and skill in the die work of the figures.

No. 1003, three saw setts, made by J. Flegel, Philadelphia, deposited by Jarvis & Webster. The committee could not discover any particular merit in these articles.

No. 1004, one card of files, assorted, made by Robert Murphy, Philadelphia, deposited by maker. These specimens embrace nearly all the varieties of the small and delicate files used by jewellers, and particularly dentists; in their general appearance and finish they closely resemble the celebrated "Stubbs" Lancashire files. We learn too that the manufacturer can furnish an article fully equal to the specimens, at prices varying from fifteen to twenty-five per cent. below the same description of English files: with perseverance and a determination to excel, by the maker, this description of English files must soon cease to be imported. For his success in producing an article so nearly like the small and fine Lancashire files, the committee think the maker entitled to the premium of a silver medal.

No. 1005, a frame and gearing with suspended doors, made by W. J. Forsyth, Philadelphia, deposited by maker. In this contrivance the committee believe that there is nothing new.

No. 1006, half dozen patent coffee mills, made by John Rittenhouse, Germantown, Pennsylvania, deposited by Joseph G. Hensey. These are well and beautifully made, and sustain the high reputation which the maker has acquired. For their general excellence and finish the committee think the maker is entitled to the award of a certificate of honorary mention.

No. 1007, a card of rasps and files, made by George Machen, Phil-

adelphia, deposited by maker. These are a good article, fully equal to any ever exhibited; they are well cut, of good proportions and strength, and in the strength of the tangs are superior to the foreign article of the same description; the maker is entitled to a certificate of honorary mention.

No. 1008, one silver mounted hunting sword, made by Jacob Faser, Philadelphia, deposited by maker. This is a well made article, got up in superior style, and highly creditable to the maker's skill and taste.

No. 1009, four pieces britannia ware, made by Joseph Morrow, Philadelphia, deposited by maker. These are a well made article; the color of the metal is good, the surface free from "blows," and finely polished; the soldering of the spouts and handles remarkably neat, and in general finish will compare favorably with the same description of foreign goods.

The forms of these articles might be improved without adding to the expense of the manufacture, by the makers exercising a little more taste. The committee think these specimens entitle the makers to the award of a certificate of honorary mention.

No. 1010, one revolving rifle gun, made by John Herr, Freindsburg, Berks county, Penna., deposited by Christr. J. Fell; in this article the committee could not find much to admire either in taste, or workmanship.

No. 1011, one coffee mill, made by A. Pritz, Hanover, Penna., deposited by A. Maslin; this appears to be a fair, serviceable article.

No. 1012, three cast-iron planes, made by the Savage Manufacturing Company, Hanover county, Maryland, deposited by Yarnall & Walton. These are new articles, and appear to be well made for service; their merits, however, are not known to the profession.

No. 1014, one stand of sample gravitating locks, made by S. C. Bemis, Springfield, Massachusetts, deposited by E. F. Moody. These appear to be a good article, well and tastefully made.

No. 1015, one of Jenk's patent carbine, made by N. P. Ames, Chicopee Falls, deposited by E. S. Handy & Co. This article is well made in every respect in strength and proportions; it is faultless. Of its peculiar merits in loading at the breech, the committee are unable to give an opinion.

No. 1017, one case of rules, made by Bremner & Co., New York, deposited by Foote & Thompson. These appear to be a well made and good article: creditable to the maker.

No. 1018, one case of sample wrenches, made by Merrick, Springfield, Massachusetts, deposited by Foote & Thompson. These are good, fully equal to any others in the exhibition.

No. 1020, one case of guns, rifle and musket, made by John Krider, Philadelphia, deposited by maker. All these articles are excellent specimens of the maker's skill; in strength, just proportions, good taste, and excellence of workmanship and finish, the committee think them the best articles of the kind ever exhibited, and fully entitle the maker to the award of a silver medal.

No. 1021, four bundles of scythes, made by Mansfield & Holman,

Smithfield, Rhode Island, deposited by Wm. P. Cresson & Co. These are all well made, and fully equal in all respects to any exhibited at former exhibitions. The domestic manufacture of this article, has, for several years, entirely excluded the importation of the foreign article.

No. 1022, one case of rules, made by Herman Chapin, New Hartford, Conn., deposited by William P. Cresson & Co. These are a good, creditable article.

No. 1023, two card handles, made by F. Stanly, N. Britain, Conn., deposited by W. P. Cresson & Co.

No. 1024, eight planes, made by E. W. Carpenter, Lancaster, Pa., deposited by Yarnall & McClure; these are a well made, and appear to be a good, serviceable article.

No. 1026, one card and four packs of pins, made by Slocum, Jillson & Co., Waterbury, Conn., deposited by F. V. Krug & Co.; this being comparatively a new article of American make, claimed much of the time and close attention of the committee. In the production of this article the manufacturer has been eminently successful; the specimens exhibited are well made in every respect, the heads smooth, the shanks well proportioned, smooth, and elastic, and the whole article beautifully finished. The committee think the maker entitled to the award of a silver medal.

No. 1027, three scythes, made by Hale, Waters & Co., Millbury, Massachusetts, deposited by Smith & Lewis; these are good, and equal, in all respects, to any other specimens exhibited.

No. 1028, two cards of door locks, latches, and door springs, made by T. L. Littlefield, Philadelphia, deposited by maker; these are all well made, and beautifully finished articles, in design and execution highly creditable to the maker; they appear to be well contrived for use, and worthy the attention of the trade. The maker is entitled to the award of a certificate of honorary mention.

No. 1029, one frame hay and manure forks, made by John F. Hopkins, West Cambridge, Massachusetts, deposited by David O. Prouty. These are elegant specimens of the maker's skill, the forks being beautifully finished, and highly elastic; the maker is entitled to the award of a certificate of honorary mention.

No. 1031, forty sheets of sand paper, made by Betts, Lafferty & Co., Philadelphia, deposited by maker. This is a good article of the usual quality to be found in the trade.

No. 1032, one case of butchers' knives, &c., made by Henry Huber, Jr., of Philadelphia, deposited by maker; we are glad to notice the improvement presented in these specimens; they are an article of very general demand, and have constituted quite an item in our importations. The specimens are of good proportions and strength, and withal well finished; the maker is entitled to the award of a certificate of honorary mention.

No. 1035, one case samples of awl blades, made by Thorp & Hall, Philadelphia, deposited by makers; these are a new article of American manufacture, being the first, we believe, exhibited; a little more experience, we doubt not, will enable the makers to produce an article

in all respects equal to any imported. For the general excellence of these specimens, the committee think that the Institute will be warranted in awarding a certificate of honorary mention.

No. 1037, one bench vice, made by C. C. Chapman, Philadelphia, deposited by maker; this appears to be a well finished article: it is adapted to holding parallel and wedge form figures; for the design and workmanship, the maker is entitled to a certificate of honorary mention.

No. 1038, one box of cotton and wool cards, made by Prentiss & Brother, Philadelphia, deposited by maker; these are a good article, and fully sustain the makers' reputation.

No. 1039, lot of sad irons and hollow ware, made by Savery & Co., Philadelphia, deposited by makers; it is highly gratifying to observe the very great improvements which have been made in the manufacture of these articles. The sad irons are remarkably smooth in the casting, the handles well made, of good form, and the face and sides of the iron finely finished. The hollow ware is decidedly the best ever exhibited; the form is good, remarkably smooth, and of great evenness;—for these excellencies the committee think the makers entitled to the award of a silver medal.

No. 1040, a case of lever suspender buckles, made by James Bingham, Philadelphia, deposited by maker; these articles are silver, and should more properly come under the notice of the committee on silver ware; in the judgment of the committee, however, they are a neat, well made article, and highly creditable to the maker's taste.

No. 1042, eight signal lanterns, made by Wm. Porter, Trenton, N. Jersey, deposited by Charles Jewell; these are a fair article.

No. 1043, one fifty blade knife, made by W. Richardson, Philadelphia, deposited by C. C. Watson; the committee doubt whether this is American make, at all events, it is a useless article, and of inferior workmanship.

No. 1044, a case of britannia ware, made by Hall, Boardman & Co., Philadelphia, deposited by makers; these articles will bear examination; the color of the metal is a good imitation of the English "britannia metal," the surface is good, and finely finished, the soldering neat; in all respects they are highly creditable to the makers, and fully equal to any exhibited. The forms of many of these articles might be more graceful, without additional expense to the maker; the makers are fully entitled to the award of a certificate of honorary mention.

No. 1048, one pair of steel skates, made by Frowert, Philadelphia; these are disreputable to the maker and depositor, Frank Shoemaker.

No. 1061, one case of tailors' shears and hair scissors made by R. Heinisch, Newark, New Jersey, deposited by J. H. Harkness, Philadelphia; these articles are, in all respects, worthy the high reputation of the maker. In no branch of American cutlery has greater perfection been attained than in this; the committee have met with nothing equal to it from the most celebrated foreign workshops. In weight, strength, proportions, adaptedness, and beauty of finish, nothing more

can be desired; for these excellencies the committee think the maker entitled to a silver medal.

No. 1062, two shovels, one spade, and one saw, made by A. Wood & Brother, Philadelphia, deposited by makers; these are good articles, and show that the quality is not declining.

No. 1063, one patent metallic door plate, made by J. L. Bowker, Philadelphia, deposited by maker; we confess that the word patent always startles us—we generally find something worthless beneath it:—of the peculiar merits of this article we have no opinion to give.

No. 1064, lot of lock castings, made by C. Manfield, Elizabethtown, deposited by James Bradfield; these are good, the surfaces being smooth and free from imperfections.

No. 1065, one case of locks, made by August Prutzman, Philadelphia, deposited by maker; the most remarkable and interesting specimen in this case is a *safety lock:* this lock presents an ingenious combination of the many tumbler lock of Mr. Barron, with the detector principle of Chubb, and several other devices of additional security. The key hole is covered with a strong boss of brass, which is imbedded in the face of the lock, and secured by three buttons on the combination principle, admitting seven hundred and twenty-nine changes; within the lock is a steel plate covering, the key hole of which can be removed only by pressing a secret spring placed within and near one corner of the lock. This spring must be pressed by a small steel wire, and at the moment of removing the plate sets off an alarm bell which continues to sound for several minutes. The tumblers are ten in number, five are pressed down in unlocking, and five are pressed up. The tumblers are not connected with the bolt, but when they are thrown into the proper position, allow a stop of steel to take the position required for the freeing of the bolt, which is then drawn by a knob handle independent of the key. From this brief description, it will be seen that this lock is of most ingenious contrivance. The workmanship is of the very best kind; the committee think that the ingenuity, skill, and excellent work exhibited in this lock entitle the maker to the award of a silver medal.

No. 1069, one card of files, made by Thomas Perrins, Philadelphia, deposited by maker; these files are of good strength and proportions, and appear to be well cut; part of them are, however, in a soft state. The maker certainly deserves credit for the strength he has given to the tangs of these files—the English being generally too weak in this respect; the whole card will compare favorably with any others in the exhibition.

No. 1070, one card of butt hinges, made by the New England Butt Hinge Company, Providence, R. Island, deposited by E. J. Fenner; this article is becoming one of great value and importance in American industry; it will soon take its place among the list of other American goods which have entirely excluded the foreign. These specimens are all loose, parliament, broad and narrow hinges; the samples exhibited, embracing the card and a number of bundles taken from the shelves of the depositor, have been subjected to most careful examination; the committee find them to be strong, well proportioned, the joints good, the castings remarkably smooth, free from defects,

and the screw holes round and properly countersunk. The committee think them the best article of the kind ever exhibited, and entitle the maker to the award of the silver medal.

No. 1071, lot of iron rivets, assorted, made by Farris, Edes, & Co., Plymouth, Massachusetts, deposited by Heaton & Denckla; these appear to be a good article, the smaller samples particularly.

No. 1072, one card of files, made by W. & R. Davis, New York, deposited by Heaton & Denckla; these are samples generally of the smaller kinds, and imitations of the "Lancashire;" they are very creditable to the makers, and prove what we may expect from them with a little more practice in their manufacture; they are not, however, equal to No. 1004.

No. 1073, three cards of locks, made by Lewis McKee & Co., Terrysville, Connecticut, deposited by Heaton & Denckla; it is surprising how rapidly American skill is meeting the wants of the community; the samples are closet and chest locks, for which there is an almost unlimited demand. These articles are well made, strong, adapted to use and wear, and must soon entirely supersede foreign importations.

No. 1075, one card of spring cutlery, pocket and pen knives, made by Bradley & Beecher, Nangatuck, Connecticut, deposited by Heaton & Denckla; these are a good, close, imitation of the fine English knife; a few years ago they would have obtained for the makers the highest honors of the Institute—at present they only take rank among the same articles made by other American makers. In saying this we do not mean to depreciate these goods, but rather to show the progress which this branch of our arts has made.

No. 1077, one lot of carpenters' planes, made by John Colton, Philadelphia, deposited by maker; the committee after a careful comparison of these planes with those deposited by other makers, decide them to be the neatest and best finished in the exhibition, and entitle the maker to the award of a certificate of honorary mention.

No. 1080, two cases of hooks and eyes, made by S. J. North, New Britain, Connecticut, deposited by J. D. Byerly; these are good and creditable to the maker.

No. 1083, one card, or case, of fine table cutlery, made by J. Russell & Co., Greenfield, Massachusetts, deposited by Curtis & Hand; in these specimens we have another gratifying evidence of the rapid advance which this branch of American cutlery has made; this work is highly creditable to the makers, and will bear a close comparison with the best English table cutlery; it is well forged, tempered, ground, and polished, and finished in good taste, for all which the makers are entitled to the award of a silver medal.

No. 1084, one case of wood screws, made by the New England Company, deposited by Curtis & Hand; the committee think that these screws cannot be surpassed, or improved, in any respect; they are equal to the specimens for which the Company obtained the medal of the Institute at the last exhibition.

No. 1085, one card of screw wrenches, made by S. Merrick, Springfield, Massachusetts, deposited by Curtis & Hand; these are a good

article, but in no respects better than have been deposited in former exhibitions.

No. 1086, one card of plane irons, made by W. Field, Pawtucket, Rhode Island, deposited by Curtis & Hand; these appear to be well made, highly creditable to the maker, and are said to give general satisfaction to the trade. The committee, however, think that they are not superior to what we have had at former exhibitions.

No. 1087, one card of pins, assorted, made by Mitchell & Witherill, New York, deposited by Curtis & Hand; the committee devoted a large portion of their time to the examination of these pins, and though they are highly creditable to the makers' skill, they lack, in the estimation of the committee, the smoothness of head, and general fineness of finish observed in specimens No. 1026; yet, on account of their near approach to No. 1026, in general excellence, the committee think the maker entitled to the award of a certificate of honorary mention.

No. 1088, one card of bolts, made by Mattison, Russell & Co., New Britain, Connecticut, deposited by Curtis & Hand; these are a good article, and well adapted to the purposes for which they are intended.

No. 1089, one card of saws, made by Jonathan Paul, Philadelphia, deposited by Thompson & Carr; in this article there is nothing to elicit particular notice: they are good, and a fair specimen of what our manufacturers of that article usually furnish.

No. 1090, one case of trunk locks, made by Goodwin & ———, Terrysville, Connecticut, deposited by Thompson & Carr; these are comparatively a new article to which American industry has been applied; the makers have been quite successful in producing a strong, neat, well finished article, superior, in these respects, to the ordinary English trunk lock; they are entitled to the award of a certificate of honorary mention.

No. 1091, one patent safety lock, made by Thomas P. Murphy, deposited by maker; this is a safety lock, and is designed particularly for banks: it is worked with three keys, and may be said to consist of three locks securing each other. The design of the maker is that the keys shall be kept by separate persons, as the lock appears to be so ingeniously contrived as to defy the art of picking; it follows then that concert among the keepers of all the keys is indispensable, in order to open the lock. This lock is most ingeniously contrived and skilfully made; the workmanship is of the very best description—whether the inventor and maker of this ingenious and complicated lock is applying his talents and skill to the best account, it is not for the Franklin Institute to judge, but for the ingenuity, skill, and excellence of workmanship the committee think the maker entitled to the award of a silver medal.

No. 1092, three hones, made by W. McCalla, Philadelphia, deposited by maker; the committee could not discover the particular merit of these hones, if they possess any.

No. 1094, lot of circular saws, made by Hoe & Co., New York, deposited by Edward Frick; these are good, free from winding, and equal to the article in general use.

No. 1096, one repeating rifle, made by H. Gross, Tifton, Ohio,

deposited by J. C. Smith; the workmanship on this article is beautiful in every respect, and extremely creditable to the maker. Of the value of this invention the committee cannot speak, unless it be to secure business for the surgeon, or the undertaker.

No. 1097, one safety bolt, made by Howell & Smith, Philadelphia, deposited by makers; this bolt is so constructed as that when it is "pushed home" it is secured in its place by a small lock forming one of the staples of the bolt. The article is very well made, but it is doubted by the committee whether the inconvenience of locking and unlocking the bolt, added to that of occasionally mislaying, or losing, the key by those with whom it may be entrusted, will not prevent them from being generally used.

No. 1100, one stand of sample stair rods, made by Edward Jones, Philadelphia, deposited by maker; the finish of these specimens is highly creditable to the skill and taste of the maker; in these respects they are all that can be desired—he is entitled to a certificate of honorary mention.

No. 2007, three boxes of hooks and eyes, made by S. J. North, New Britain, Conn., deposited by E. H. Worne; these are a fair and good article.

No. 2041, one box of curtain pins and bureau knobs, made by J. B. Chevalier, Philadelphia, deposited by W. M. Muzzy.

No. 2045, two shovels and one spade, made by T. C. Wood, Philadelphia, deposited by maker; these are beautiful specimens of the maker's art, and in all respects well made.

No. 2053, three grain shovels and scythe snead, made by John Weightman, Philadelphia, deposited by maker; in excellence these will compare with any in the exhibition.

No. 2501, three rakes, wood and iron, made by Henry Porter, Northumberland county, Penn., deposited by G. H. Brown; these appear to be well made, and adapted to the purpose for which they are used.

No. 2551, three shovels, made by J. Richards, jr., Philadelphia, deposited by maker; these also are well made; as a general remark the committee think that in the articles of shovels and scythes there is but little room for improvement.

No. 2562, one case of shuttles, made by E. D. Tripp, Trenton, N. Jersey, deposited by A. W. Tiffany; these are well made, and unusually well finished; they are so highly creditable to the maker, that the committee think him entitled to the award of a certificate of honorary mention.

No. 2570, wire screens, riddles, &c., made by J. & D. Sellers, Philadelphia, deposited by John McClane; these goods the committee think cannot be improved; the weaving is perfect; they are, however, only fair samples of what these manufacturers have long since exhibited and furnished to the trade. It is pleasant thus to see a good reputation sustained.

No. 2590, a coffee urn, made by John Harned, Philadelphia, deposited by maker.

No. 2619, counter scales, made by G. R. Moore, Philadelphia, deposited by maker; these are a good, serviceable article.

No. 2623, three scales, made by T. Meyer & Co., Philadelphia, deposited by Gray & Co.

No, 2612, one set of platform and counter scales, made by J. D. Dale, Lansingburg, New York, deposited by Gray & Brother; the platform scales come under the notice of the judges on models and machinery. The counter scales appear to be well made, but in the judgment of the committee they are rather complicated for ordinary use; the slightest derangement must subject the buyer, or seller, to loss, and they may be made the means of petty frauds in the hands of knaves.

No. 1101, one curriers' knife, made by Stephen Parry, Philadelphia, deposited by maker; this is a well made and beautiful article in every respect, and entitles the maker to the award of a certificate of honorary mention.

No. 1098, card samples of brass molasses gates and turn buttons, made by G. Jordan, Philadelphia, deposited by maker; these are creditable to the maker.

No. 1106, one case of pocket and pen knives, made by W. Wild, New York, deposited by W. Murdock; the committee have examined these articles with great care—as it is one which enters largely into our foreign purchases;—it is a branch of business affording great scope for skill and good taste. In the judgment of the committee these specimens, while they do not show any decline in this branch, are not superior to specimens deposited in former exhibitions.

Three mill saws, a good article for the purpose, (without No.)

No. 1103, one circular saw, made by Chas. Johnson, Philadelphia, deposited by Curtis & Hand; this article is equal to any others in the exhibition.

No. 2658, lot of wire screens, made by Thomas S. Speakman, Philadelphia, deposited by maker; these are equally as well made as others in the exhibition.

No. 2560, sample cards and bundles of cast-iron butt hinges, made by Morris, Tasker & Morris, deposited by makers; the sample cards embrace several varieties of fast and single joints, and are very creditable to the makers. The committee examined with great care the quality of those in bundles, and they regret to say that they found them to be inferior to the samples; the casting is rougher, the joints less perfect, and the screw holes irregular. These are defects which must be corrected before the article can find favor with the trade, or the public, and we doubt not that the well known ability, perseverance, and skill of the makers, will enable them to produce an article in all respects equal to any in the market.

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## AMERICAN PATENTS.

*List of American Patents which issued in the month of July*, 1844, *with Remarks and Exemplifications. By* CHARLES M. KELLER, *Examiner of Patents.*

1. For an improvement in *Ploughs;* Jonathan Mooerers, Hazleton, Luzerne county, Pennsylvania, July 1.

The standard, or sheath, of this plough is cast with the mould board, and is rebated on the land-side to receive the cutter, which thus overlaps it and the mould board; the cutter being fastened by a bolt which passes through it and the land-side, and by a projection from the share that holds the lower end, the upper end being fastened to the beam, which it enters in front of the standard, by a plug, or wedge.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the cutter constructed and arranged as described, in combination with the sheath and beam, as above set forth."

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2. For an improvement in the method of securing *Boring Machines* to pieces of timber that are to be bored; Peter Baylor, near Salem, Columbiana county, Ohio, July 1.

The machine is secured to the timber by means of a hook jointed to the end of a lever, connected with the machine by a bolt that passes through a slot in the lever, and another in an axle, in such manner that the position of the lever and hook may be varied to suit timbers of various sizes, &c.

Claim.—"What I claim is the combination of the oblong, perforated, vibrating axle, the oblong, perforated lever, connected thereto by a screw bolt, the hook for grasping, or gripping, the article to be bored, with the machine for boring, in the manner and for the purpose set forth."

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3. For an improvement in *Bee Hives, or Palaces*: Jacob D. Falkerson, Unity, Columbiana county, Ohio, July 1.

The palace is a square box divided into four compartments by two vertical partitions at right angles, the one that is parallel with the two doors, on the front and back, extends from the bottom to the top, where there are apertures for ventilation; each of these apartments is divided into three stories by shelves that incline from the doors towards the main partition, the back edge of the shelf not coming quite up to the partition, but leaving sufficient space for the entrance of the bees, there being vertical partitions that extend from the bottom of one shelf to within a short distance of the top of the next. The main partition only extends down from the top to the third shelf, and from the lower end of it two boards extend out, one on each side, at an inclination the reverse of the shelves, and about half of the lowest compartment has the same inclination, thus leaving a passage for the bees. The under edge of the last named inclined board, and the bottom of the lowest compartment have pieces of glass attached to them, and of less inclination, that form receptacles to catch the moth, and prevent their entrance to the hives; below these pieces of glass are placed the lighting boards, and shield boards.

Claim.—"What I claim is the combination and arrangement for defending the hopper-formed entrances, by means of the glass placed

around the entrance thereof, and the shield boards constructed and arranged as above specified; the form of the hive being as set forth."

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4. For an improvement in *Blacksmiths' Forges;* Frederick A. Stewart, Catharine, Chemung county, New York, July 1.

The hearth of the forge is made to slide up and down in a sink, or well, provided with an aperture at the bottom for the removal of the cinder, &c., when the sink has been filled up.

Claim.—"What I claim as my invention, is causing the fire, cinders, and dirt to descend into a well in the bed of the forge, when fresh coal is to be supplied, without disturbing the fire, and accumulating the cinder and dirt on the hearth as in the common forge, the cinder and dirt being removed from said well through an aperture, or opening, at the bottom thereof; and this principle I claim whether it be effected in the manner set forth, or in any other mode in which analogous means are used."

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5. For improvements in machinery for making *Barrels and Casks;* Isaac Crossett, East Bennington, Bennington county, Vermont, July 1.

The staves and heading are cut from steamed timber, by means of knives; the cutter for the staves is of a curve equal to the circumference of the barrel, and the bed on which the block rests vibrates on centres instead of the cutter, for the purpose fully expressed in the claim. In the machine for cutting heading, the knife, or cutter, is attached to one lever, and the bed on which the block rests to another, by which means any amount of draw can be given to the cut. And in the machine for trimming, or forming, the heads, the mandril (which holds the head,) is supported in a frame separate from the frame in which the mandril of the cutters work, so that the one can be presented to the other, the frame of the former sliding on that of the latter. There are two sets of cutters, or segments of saws, attached to a face plate, one being attached to, and parallel with, the face, and the other attached to the periphery, and forming segments of a hollow cylinder, so that by presenting the head to these cutters, or saws, at an inclination, and giving it a slow rotary movement, both bevels are formed at one operation, instead of two, as heretofore.

Claim.—"What I claim, is, first, in the heading cutter, attaching the knife and bed each to a lever, so arranged as to cause the knife and bed to move in opposite directions, by means of which arrangement more or less draw can be given to the cutter, as described; second, in the stave cutter the vibratory motion given to the head piece, by which means the labor of feeding the machine is greatly facilitated, inasmuch as the bed is inclined downwards towards the gauge when it is ready to cut, (which makes it feed easily,) and from the knife after the cut; so that the block can be more easily withdrawn to turn it in the machine, or to take off the core; third, in the head machine, the fixing of saws or cutters, in the face and on the

periphery of a revolving wheel, to cut complete heads at one operation from pieces presented to it under an angle, as set forth."

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6. For an improvement in *Fire Arms;* William W. Hubbell, Philadelphia, Pennsylvania, July 1.

The patentee says,—"The nature of my invention consists in detaching so much of the breech end of the barrel as will contain the charge, from the main part of the barrel, by having it to flap over to one side of the barrel, on a rod which runs parallel with the barrel, and thus expose itself to receive the charge, after receiving which it is flapped back to discharge the load through the main part of the barrel.

Claim.—"What I claim as my invention is the breech opening and closing on a rod, as a centre, which runs parallel with the main barrel in the operation of firing fire arms."

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7. For an improvement in the *Supply Pipes of Aqueducts;* John H. Thorndike, Boston, Massachusetts, July 1.

The patentee says,—"My improvement consists in adapting a cylindrical shaped filtering vessel to the aqueduct delivering, or supply, pipes, in such a way that the head, or elevation, of the water may be availed of, and the water be made to flow to as great a height, (after passing through the filter,) as it would if said filter were not used."

Claim.—"It should be particularly noted, that by my improved arrangement the water is filtered without obstructing, or checking, its tendency to rise by the force of its head, so that, in fact, the pipe from which the filtered water is drawn, is but a continuation of the aqueduct delivering pipe, the filtering material, or chamber, only intervening, or being inserted between the two. I am aware that water has been filtered heretofore by the force of its head, and, therefore, do not lay claim to any such arrangement. I claim the combination with the three apartments of the filtering apparatus, of the three pipes, in the manner described."

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8. For an improvement in the *Safety Lock;* Marcus R. Stephenson, and Oliver Edwards, Boston, Massachusetts, July 9: the right of Stephenson assigned to E. Holman.

On the 17th of April, 1844, two patents were granted to these persons, for improvements in locks, having the same object in view as in this, and therefore the reader is referred to pages 418 and 419 of the eighth volume, third series, of this journal, for a statement of the object. In this lock the main tumbler, or "lever plate," is adapted to the reception of a secondary lever plate jointed to, and moving with, it longitudinally, but having a vertical play within it, and kept in the required position within the main "lever plate," or tumbler, by means of an interposed spring, so that a projection on the bolt can pass freely through the slots in both, when brought to the required position by

the key acting on the main one; but when pressure is applied to the bolt, in attempting to pick the lock, the projection on the bolt presses against the end of the secondary lever, and prevents it from moving with the main lever, or tumber.

The application for this patent was declared to interfere with a patent granted to Robert Newell, on the 14th of June, 1843, (not yet noticed in this journal,) and on a hearing before the Commissioner of Patents, the priority of invention was declared in favor of Stephenson and Edwards, and this patent thereupon granted to them.

Claim.—"We claim the secondary lever plate, in combination with the main lever plate, the same being applied thereto, and operating therewith, as before described."

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9. For an improvement in the mode of *Detaching Horses from Carriages;* John Madden, Warren, Trumbull county, Ohio, July 9.

At the back of the whipple-tree there are two "revolving shafts," extending from near the middle to the ends; the ends of these shafts are bent at right angles, and they are so arranged that the outer end of each one, which is flattened for that purpose, covers the end of the pin on the whipple-tree, to prevent the traces from flying off, and to the inner ends a cord is attached to enable the driver to turn the shafts, and thus uncover the ends of the pins, and permit the traces to escape.

Claim.—"What I claim as my invention, is the combination of the revolving shaft, arms, and cam, with the whipple-tree, in the manner and for the purpose described, the whole being constructed and arranged as before specified."

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10. For an improved mode of *Hanging Carriage Bodies*; John Reynolds, Newberry, Lycoming county, Pennsylvania, July 9.

Claim.—"I am aware," says the patentee, "that springs have been attached to the bottom of the carriage, and that these have been connected with the frame by means of levers, and, therefore, I do not claim this general arrangement as of my invention; but what I do claim as my invention, and which I desire to secure by letters patent, is combining the springs, which are arranged within the seat of the carriage and the levers, jointed to the body of the carriage, with the cranked shafts, one of which is permitted to rock, and both being so connected and arranged as to admit of being reversed with facility, to hang the body of the carriage high, or low, as described."

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11. For an improvement in *Washing Machines;* Oliver B. Wight, Sturbridge, Worcester county, Massachusetts, July 9.

The box containing the clothes slides back and forth on a frame, and is provided with rollers along the bottom, on which rests a cloth fastened to the box at each end; there is a "rocking beater," (the shaft of which has its bearings working in slots in two standards of the main frame) with the bottom cylindrical, with slots projecting from

the periphery at such distances apart as to correspond with the spaces between the rollers at the bottom of the box. The clothes to be washed are placed on the cloth, and by rocking the beater they are squeezed in between the rollers as the box vibrates.

Claim.—"What I claim as my invention is the combination of the rocking beater with the flexible bottom ("cloth") rollers and vibrating box, arranged and operated in the manner and for the purpose set forth."

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12. For improvements in the *Cooking Stove;* James Wager, Troy, Renssalaer county, New York, July 9.

Claim.—"What I claim as my invention, is the manner in which I have combined my fire place with the other parts of the stove, by placing it on the rear side thereof, in direct contact with the back flue, in the manner and for the purpose set forth. I claim also the connecting of the space, or depression, in the sunk hearth, with the fore end of the fire chamber, by means of the cavity, as described, and substantially in the manner and for the purpose made known."

"By placing the fire chamber," says the patentee, "against the back flue, the air within that flue is rarefied immediately on the lighting of the fire, and a perfect draught through all the flues is thereby rendered certain." From the hollow hearth, made in the usual manner, a hollow cavity extends up to the fore end of the fire chamber.

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13. For improvements in the *Cooking Stove*, known as Isaac B. Bucklin's *Railway Cooking Stove;* John B. Chollar and Horner Parmelee, West Troy, New York, July 13: assigned to John B. Chollar, Eben Jones, and Peter Law.

Claim.—"We do not claim any of the above described different parts separately, nor do we claim any part of the railway cooking stove as patented by Isaac B. Bucklin, or other stoves with movable grates, or fire chambers, as our invention; what we do claim, therefore, and desire to secure by letters patent, is the arrangement and combination of the aforenamed several parts, as follows:—The arrangement of the flues, or openings, in front and rear in the bottom below the oven plate, and in combination therewith the self-acting dampers, constructed and arranged as described, so as to enable us to do away with the sliding plate with boiler holes, as in Bucklin's patent, with his alternating openings on the top of the fire chamber, and substituting in its place our improved fire chamber top with its plates and rings, as described, with two openings, or flues, on the back end. We further claim the combination of the vertical front, rear, and horizontal flues, with their dampers in the fire chamber. We expressly say and wish it to be understood, that we do not claim any of these above described parts as new, but only in the combination described, with Isaac B. Bucklin's patent railway cooking stove, or any other stove of similar construction; that is, with a movable fire chamber, or furnace, moving to and fro under an oven, and as such we claim the invention, adaptation, and combination above named."

14. For an improvement in *Elastic Boot and Shoe Shanks;* Isaiah Gale, Natchez, Mississippi, July 11.

This is for an alleged improvement in springs put between the outer and inner soles of boots and shoes for the support of the instep. Prior to this a single steel plate was used, extending from the heel to the ball of the foot; but the present patent is for the employment of two plates overlapping nearly their whole length, one of them being attached at the heel, and the other at the ball of the foot, the other end of each one being provided with a pin working in a slot in the other, as in elliptical carriage springs, to give them free play in bending.

Claim.—"I do not claim the double elliptical spring, but what I do claim is the combination of the above described spring with the boot, or shoe, in the manner and for the purpose described."

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15. For an improvement in the *Cylinder Mill for Grinding Grain;* Jacob Groat, Troy, Renssalaer county, New York, July 11.

This improvement consists in the manner of setting the grinding surfaces of a cylinder mill, by rotating the concave about an imaginary centre not coincident with the centre of the grinding cylinder, instead of effecting this by moving the concave directly towards, or from, the cylinder, by means of which a concave can be employed extending around full, or more than, half the circumference of the cylinder.

Claim.—"What I claim as new, is the method of adjusting the case, or concave, by rotating it around the cylinder, as described, by means of the grooves, ways, and adjusting screws, in the manner and for the purpose set forth, or by any other means substantially the same."

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16. For improvements in the machine for *Hulling and Pearling Rice, &c.;* Jacob Groat, Troy, Renssalaer county, New York, July 11.

The machine which we have here, like many of the same class, consists of a reservoir and concave, or surrounding case, somewhat conical, and their rubbing surfaces are composed as fully expressed in the following—

Claim.—"What I claim as my invention is, first, constructing the revolving cone in the manner described, with alternate staves of brushes, and gum elastic, and iron, or gum elastic and iron alone, combined and operating in the manner and for the purpose set forth; secondly, I claim, in combination with the above revolving cone, a case formed of triangular shaped files, as above fully made known; thirdly, I claim the method of combining the files with the upper and lower rings, so as to be adjustable, in the manner described, by inserting them in a groove with soft pieces of metal between them, by means of which they may be driven closer together, or separated, as occasion requires."

17. For an improvement in the mode of *Regulating the Supply of Water in Steam Boilers*; John Cochrane, Newark, New Jersey, July 13.

The patentee says,—"The nature of my invention is such that it is necessary for the pump attached to the engine to be of sufficient size to meet the expenditure of water in the boiler from evaporation, and other causes, and that it be allowed to work its full capacity; the apparatus being capable, without manual assistance, of applying so much of this water as may be required to the replenishment of the boiler, and of returning the remainder back again to the pump without loss of power, or heat."

The apparatus consists of a vessel communicating with the boiler, by means of two pipes, one above and the other below the water line, and with the supply pump, by means of a third pipe; the passage to the third pipe is provided with a check valve, the upper end of the stem of which has a float that keeps it open as long as the water is at a sufficient elevation, but which permits it to close when the water sinks to the low water mark. When the water is sufficiently high, and the valve, therefore, open, all the water that is forced in by the pump follows the piston back, and runs out, but when there is a deficiency of water, and the valve is permitted to rest on its seat by the float, the water forced in does not run back until the required supply has been obtained. On the same stem with the check valve, and above it, there is another valve which commands the passage leading from this vessel to the boiler below the water line, so that when the water is sufficiently high in the boiler the float keeps this valve up against its seat, and thus prevents the surplus water from being forced into the boiler. To insure the buoyancy of the float, in case of a leak, the inside of it communicates with the pump through the valve stem, which is hollow for that purpose, and provided with a valve opening outwards, so that the downward stroke of the pump will exhaust it.

Claim.—"What I claim, is, first, the manner in which I have connected and combined the float and the check valve with the force pump, and with the boiler, as herein described, so as to allow any excess of water from the pump to return back thereto by the opening of the check valve under the action of the float; secondly, the connecting of the second valve, placed in the pipe, or opening, through which the water passes from the chamber to the boiler, with the check valve and float, so that both may be operated on by the float, for the purpose and in the manner described; thirdly, the connecting of the float internally with the pump that supplies the boiler by means of a hollow stem and valve, in combination with the check valve, so that the float may be exhausted at each stroke of the pump, and thereby be made to discharge any water that may have leaked into it."

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18. For an improvement in the *Crimp for Crimping Leather for Horse Collars;* Joseph H. Barkdull, Ballston, Saratoga county, New York, July 13.

This crimp is composed of three parts, designated in the claim by the letters *a*, *b*, and *c*, hinged together; and each part is divided in two along the middle, and connected by hinges in such manner that this middle joint of all the parts is in the same line; the hinges that connect parts *a* and *c*, with *b*, are situated at the junction of the two halves of the parts, and the axes of these hinges are at right angles with the axes of the hinges that unite the halves of the three parts, or sections, before the stretching operation is commenced, but after that the angle varies. The connected ends of the parts, or sections, *a*, *b*, *c*, are beveled from the hinges outwards, and the middle section *b*, is provided with curved tongues that fit and slide in mortises in sections *a* and *c*. The leather to be stretched, or crimped, is laid on that face of the instrument opposite the hinges, (which is a little rounding,) and is fastened to the outer edges by pins projecting therefrom, and then the parts, or sections, are turned on the connecting hinges, which enlarges and gives a curve in all directions to that face on which the leather is placed, which thus receives the required swell and curve; the whole is held together at the end of the operation by catches attached to the section, or part, *b*, and that take in notches in the other sections.

Claim.—"What I claim is the combination and arrangement of the parts *a*, *b*, and *c*, constructed and arranged substantially in the manner set forth."

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19. For an improvement in *Buckles;* Henry Lawrence, Manlius, Onondaga county, New York, July 13.

The improvement in question is for dispensing with the tongue, and holding the tug, or strap, by pressure instead thereof. The front end of the buckle is adapted and jointed to a lever, to one arm of which one of the straps is attached, the other strap, or the tug, which is to be fastened, being passed between the other arm of the lever and the plate, or main part, of the buckle, and then through a loop at the other end. From the above it will be evident that a pull on the straps forces one of the arms towards the plate of the buckle, and grips the strap, or tug, with a force proportioned to the force of the pull.

Claim.—"What I claim is the construction of the back piece and the front piece of the buckle, and the combination of the same on the lever principle, as described, causing the said front piece to be pressed firmly against the tug, or strap, so as to hold the same securely, and thus dispense with the common buckle tongue."

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20. For an improvement in the *Grain Separator, to be combined with a threshing, or winnowing, machine;* Jacob V. A. Wemple, of Mohawk, New York, and George Westinghouse, of Schoharie, New York, July 13.

The grain with the straw, if from a threshing machine, or with the chaff, if from a winnowing machine, is discharged on to the separator, consisting of separate sections, each composed of a sheet of wire

gauze, surrounded with strips of wood, to prevent the grain from falling out, and all connected together and formed into an endless chain passing over rollers by means of endless belts of leather.

Claim.—"What we claim as our invention, is the separator, as described, that is to say, a revolving screen, or separator, composed of separate portions, or sections, of wire gauze, constructed and secured by endless belts, in the manner described."

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21. For an improvement in the *Bee Palace;* Lemon Hamlin, Kirkersville, Licking county, Ohio, July 13.

Claim.—"What I claim as my invention, is the manner of ventilating the hives, by arranging them around a central vertical opening in the palace; the back of each hive being covered by wire gauze, and in combination with this arrangement, the moth trap placed at the top and bottom of said central opening, the construction and arrangement being as described."

The moth traps are placed at top and bottom of the central opening, the one at the top consisting simply of a circular case with a wire gauze bottom resting on the top of the central opening, and apertures in the case for the admission of the miller; and the one at the bottom is square with a wire gauze cap, which admits air to the central opening of the palace, and side openings, some provided with a gauze shutter, and the others with conical tubes extending in some distance, the smaller ends being within, to prevent the escape of the moth.

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22. For improvements in the *Washing Machine;* William E. Arnold, Rochester, Monroe county, New York, July 13.

The improvements claimed under this patent, are applied to that kind of washing machines in which the clothes are washed by means of a swinging beater, or dash-board, perforated for the passage of water. The first improvement consists simply in giving an inclination to this dash-board, or beater, and hinging it by the lower edge, and so connecting it at top with the swing frame that the inclination can be varied at pleasure. The object is to throw up the clothes, which are then forced back, and turned by a reciprocating wedge, that has a movement up and down by being connected with arms that project out from the top of the swinging frame, so that as the dash-board advances towards the wedge, it rises, and descends as the dash-board is moved back.

Claim.—"What I claim therein as new, is, first, the varying of the inclination of the dasher-board, in the manner and for the purpose described; I likewise claim the application and use of the reciprocating wedge, constructed and operating as set forth."

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23. For an improvement in the machine for *Crimping Leather for Boots;* Pelatiah Stevens, jr., Canton, Norfolk county, Massachusetts, July 15.

Claim.—"I claim the described arrangement of the clamping plates

and clamps, so as to extend entirely around, or in opposition with the lower edges of the boot former, and have a space between the clamp plates to receive and permit the depression of the boot former below, and its elevation above, their upper edges, in the manner set forth, the said improved arrangement of the parts enabling the attendant to stretch and shape the leather more thoroughly, conveniently and expeditiously, than by others heretofore used; and I also claim the wrinkle preventer, as applied to, or combined with, the boot former, and constructed and used substantially in the manner set forth."

The former slides up and down between the clamp plates, by means of a screw, and the edges of the leather are secured to the clamp plates by a series of clamps jointed to the plates; and the wrinkle preventer consists of a plate of metal bent in the form of a U, with the edges so curved as to correspond in form with the instep of the boot, and so connected, by means of a lever, with the frame of the machine, as to enable the operator to apply the curved edges to the leather, and prevent any tendency to wrinkle during the crimping operation.

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24. For an improvement in *Setting Logs on Saw Mill Carriages;* Francis M. Stetson, of Sangerfield, and John Eaton, of Brookfield, New York, July 15.

The slides on the head and tail blocks of the carriage to which the dogs are attached, are moved by means of screws, in a manner well known to those who are acquainted with saw mills; and for the purpose of operating the two screws simultaneously, they are connected by bevel cog-wheels, and a shaft extending from the head to the tail block, and parallel with, and at the side of, the carriage; the bevel cog-wheel on one end of the shaft being adapted to the shaft by a feather, or square socket, and connected with the tail block by a collar, so that the tail block can be moved towards, or from, the head block.

Claim.—"What we claim as our invention, is the connecting together the screws and sliding blocks on the head and tail blocks of the carriage, so as to move both ends of the log simultaneously and equally, and at the same time allowing the head blocks to recede from, or approach to, the foot block, and thus be adjusted to the length of the log to be sawed, the whole being arranged, combined, and connected substantially as set forth and described."

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25. For an improvement in the *Ice Breaker* for boats and other vessels; Samuel Nicolson, Boston, Massachusetts, July 16.

The bow of the boat is to be provided with ice cutters, or breakers, attached to a rotating shaft actuated by a steam engine, or with permanent cutters moving with the boat; these instruments cut the ice, forward of the boat, into strips, which are broken off and forced under the surface of the water by an inclined shield attached to the bow of the boat, provided with two projecting inclined surfaces that run obliquely from the middle of the forward end to the sides, to force the

broken under the unbroken ice beyond the paddle-wheels of the boat, and thus clear the channel.

Claim.—"What I claim as my invention, is making the shield, or shoe, at the bow to consist of a combination of inclined surfaces, arranged as herein described, so as to depress and carry the ice under, and on each side, the shield being as wide, or nearly so, as the extreme width across the paddle-wheels by which the boat is propelled."

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26. For improvements in *Saw Mills;* Henry Stanton, Richfield, Otsego county, New York, July 16.

These improvements are for the purpose of more effectually steadying the log whilst under the action of the saw. The first improvement consists of a bar extending from the slide of the head to the tail block, attached permanently to one, and so connected with the other as to admit of changing the distance between the head and tail blocks for different lengths of logs. Towards the middle of the length of this bar there is a bail and sliding dog, by means of which the middle of the log can be dogged to steady it; and the other improvement consists simply of a metallic plate attached to, and projecting above, the rebate of the head and tail blocks to fit into grooves cut across both ends of the log, to prevent it from slipping endwise.

Claim.—"What I claim is, first, the arrangement of the longitudinal bar and dogs attached to the ends of the slides of the head and tail blocks for supporting the log at the middle, in the manner described; second, the arrangement of the vertical plates on the head and tail blocks, for entering notches made in the under side of the log, to prevent it having any movement longitudinally whilst being sawed, as described."

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27. For an improvement in the *Bench Vice;* Lauren M. Peck, Philadelphia, Pennsylvania, July 18.

The patentee says,—"The object of my improvement is the so constructing of a vice that the jaws thereof shall adapt themselves to articles of unequal thickness, such, for example, as are tapering, or wedge-formed, and which cannot, therefore, be securely held in those of the ordinary construction. This end I attain by allowing one of the jaws, most commonly the front, or movable, jaw, to turn in a socket, like the T of a lathe rest, or otherwise to swivel on a joint, or pin, so that it may move to the requisite distance; and to admit of its so doing, I furnish the screw with a ball and socket joint, where it bears against the movable jaw; or, instead of this, I allow the screw head, or rather a washer, under it, to bear upon two projecting pieces of hardened steel on the fore side of the jaw of the vice, said two projecting pieces being in a vertical line with each other."

Claim.—"What I claim is the causing of one of the jaws of a vice, and that usually the front jaw, to swivel, or turn, in a socket, or on a gudgeon, or joint pin, for the purpose of enabling it to embrace an article firmly which may be tapering, or of unequal size at its two

ends; the same being effected on the principle, or substantially in the manner, herein set forth."

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28. For an improvement in the *Grate Bars of Furnaces;* John Kymer, Great Britain, July 19.

Claim.—"I do hereby declare that I do not make claim to the causing of steam to enter the furnace in conjunction with atmospheric air, by which the combustion is to be kept up; this having been previously done by conducting waste steam through tubes arranged beneath the grate bars, such steam having been allowed to escape through lateral perforations made in said tubes for that purpose; but what I do claim is the manner described of protecting the fire bars from being burnt out, and of generating steam to aid in the combustion of the fuel, by causing the grate bars to dip into troughs which are kept supplied with water, said bars and troughs being combined and arranged substantially in the manner and for the purpose set forth."

The grate bars are represented as quadrangular, with one of the angles dipping into troughs, arranged parallel with each other, and all connected together at the ends, there being sufficient space between the troughs, equal to the space between the bars, for the admission of atmospheric air.

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29. For an improvement on the machine for *Sewing with the running stitch;* James Rogers, New York City, July 20.

This is for an improvement on a machine patented to Benjamin W. Bean, on the 4th of March, 1843. There is a main cog-wheel designated in the claim by the letter A, which gears in a small wheel B, that gears in another wheel C, and this last one gears into another D, directly above it; the teeth, or cogs, of these wheels are made pretty much in the same form as the teeth of a crimping machine, and the piece of cloth to be sewed, in passing between these wheels, is crimped, and in its passage the crimps are carried on to a needle which lies in a groove cut in the circumference of the wheels, and so curved as to lie between the wheels D, C; it is then curved down around one quarter of the circumference of the wheel C, where it gears with wheel B, then around wheel B, where it gears with wheel A, and extends for a short distance on the periphery of this latter one, the point lying between it and another wheel F, similar to B, but a short distance from it.

Claim.—"I hereby disclaim the original invention of sewing cloth by machinery with a running stitch, but what I do claim is the arrangement of the wheels A, B, C, and D, in combination with the needle having but two bends which allows the machine to work much better, being more simple in its construction, and thereby having five wheels less than the original machine."

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30. For a process for *Renovating Tobacco after it has become mouldy;* Enoch Huse, Newburyport, Essex county, Massachusetts, July 22.

This process consists "in immersing, or soaking, the package of tobacco in water for five minutes, or upwards, as circumstances may require; and as the tobacco is usually packed in boxes, or kegs, these are generally introduced, filled with damaged tobacco, into the vat of water. This being accomplished, and the water having penetrated the tobacco to the necessary degree, which a little practice will soon enable a workman to determine, the tobacco is next removed from the vat, and put into an oven, or drying room, and there subjected to such a heat as may be necessary to entirely, or nearly, dissipate the water, and destroy the mould; the said heat varying, according to circumstances, from one hundred degrees of Fahrenheit, to such a heat as the article will bear without scorching, or burning, to an injurious degree. In order to produce this heat any of the known modes may be adopted; the article is then subjected to powerful pressure, in the same manner as tobacco is usually pressed into boxes, or kegs, for the merchants, or market.

Claim.—"I claim the said process substantially as described."

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31. For an improvement in *Washing Ores;* Nicholas Troughton, Swansea, England, July 22.

Heretofore ores in the process of washing for separating the metallic particles from the refuse matter, have been subjected either to a vertical, or a horizontal, current of water; but by this improved process they are subjected to the two currents at the same time, by which the drop, or lighter, matter is more effectually separated from heavier metallic particles. The apparatus described for applying this process consists of a series of sieves separated by partitions, and surrounded by a casing with a valve opening upwards, and placed at one end of the series; the ground, or pulverized, ore is placed in the sieve next to the valve, and the whole receives a vertical reciprocating movement in a vessel of water. On the descent of the sieves a current of water passes through the meshes of the sieves and the valve, the former in a vertical direction, carrying up the ore, and, of course, the drop, or lighter, matter higher than the metal, and the latter taking a horizontal direction after passing the valve, in consequence of its volume, and carrying the drop with some of the metallic particles to the next sieve, and so on through the series.

Claim.—"What I claim consists in separating the ore from the refuse matter, &c., by subjecting the whole to the action of vertical, or nearly vertical, and horizontal, or nearly horizontal, currents of water in combination, whether these currents, or either of them, be produced in the manner herein described, or by any other, suitable for the purpose. I also claim the combining with the series of sieves a casing, extending around, or partially around, the series, as set forth, and a valve, or valves, arranged, with respect to the series, as described, or in any other manner, so as to produce the intended effect, so that when the whole is placed in a tank of water the upward and onward currents required for the process of separation, above described, may be obtained by simply causing the series of sieves to move up and down, or, in other respects, as specified."

32. For combining a *Fire Fender with And-Irons;* Morgan Morgan, jr., New York City, July 22.

The fender is connected with the pedestals of the and-irons by means of hinges constructed in any known manner of making separable hinge joints.

Claim.—"What I claim is a new mode of applying a fender to and-irons by the means of joints, hinges, slides, and hanging upon the bars, so that the and-irons may be movable."

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33. For improvements in the *Apparatus for supplying Boilers with Water, and for improvements in the Steam Engine;* Daniel Barnum, Bridgeport, Fairfield county, Connecticut, July 24.

At page 248 of vol. xxvi, 2d series, of this Journal, will be found a notice of a patent granted for combining an auxiliary rotary engine with the boiler and supply pumps, by means of a float and valve within the boiler, in such manner that the descent of the water shall open the valve and admit steam to start the engine, and thus supply water. Under the present patent a reciprocating engine is employed for the purpose of working the supply pump, when the descent of the float in the boiler opens the valve that admits steam to it, and for this purpose the valves are so arranged that the admission of steam will start the engine in any position in which the piston may have stopped. The piston rod of the engine is provided with an arm, the outer end of which embraces and slides on a cylindrical rod attached to a crank arm on the rock shaft of the slide valves for the purpose of operating them, there being a stop at each end of the rod, with a spring interposed to ease the blow when struck by the arm on the piston rod, and insure the complete shifting of the valves, although the stroke of the piston may not be complete. As a guide and regulator of the operation of the valves, there is an arm projecting from the rock shaft of the valves, the end of which works against (first under and then over,) a guide plate attached to the arm that projects from the piston rod, and which, therefore, moves with it; for the guide plate is substituted a plate with a curved groove, which receives and guides the arm of the rock shaft, the groove being so formed as to close the valve at any point required, and thus answer the purpose of a cut-off. The piston rod of this auxiliary engine is attached to the piston of a pump, which, by an arrangement of pipes and cocks, can be used either to supply the boiler, or to extinguish fires. The float within the boiler is placed in a case provided with a pipe that passes through the boiler for the purpose of blowing off the contents of the float case, or box, independent of the boiler.

Claim.—"What I claim as new, is, first, the within arrangement for blowing off the contents of the box, by means of the pipe, independently of blowing off the general contents of the boiler; I claim the manner in which I have combined and arranged the small auxiliary steam engine, the fire engine, with the supply pump, by which the action of the slide valve is regulated, and the water supplied to the boiler; I claim the peculiar manner of regulating the cut-off of a

steam cylinder herein described, whether applied to the small auxiliary engine for filling the boiler, or to any other steam cylinder to which it may be adapted; I claim the manner in which I have combined the double valve, with the float and the auxiliary engine, for the purpose of insuring its ready action in the boilers of high pressure engines. I do not claim to be the first to have used two valves upon one stem, this having been done before in what is called the balance valve; but I do claim the special arrangement of the double valve, in the combination, and for the purpose described." [The object is to balance the valve, that the float may operate independent of the pressure of steam within the boiler.] "And I do hereby declare," says the patentee, "that I do not claim to be the inventor of the application of an auxiliary engine made to operate by the agency of a float, so as to set in motion a supply pump for the supplying of a boiler, a method of doing this having been described by Isaac N. Coffin, and patented by him on the 13th day of September, 1839; but I limit my claims, as above specified, to the arrangement and combination of the respective parts of the apparatus, as made known; nor do I claim the using of a box to inclose the float, excepting when this is done both at top and bottom, and in combination with a tube, by means of which arrangement the float is guarded against the effects of foaming: and I do hereby further declare that I do not intend to limit myself to the precise form and arrangement of the apparatus, as described, but design to vary the same as I may find expedient, whilst I attain the same ends by means substantially the same. I have, for example, now in operation on board the steamboat 'Croton,' on Long Island Sound, an apparatus constructed by me, and substantially the same with that described, but instead of the single steam cylinder of the auxiliary engine, I have used two cylinders, the piston rods of which are attached to a three throw crank shaft; two of the cranks having the two steam piston rods attached to them, and the third working the supply pump, an arrangement that will probably be preferred, as operating more steadily than the single cylinder engine."

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34. For improvements in the *Auxiliary Steam Engine for Supplying Steam Boilers;* Henry R. Worthington, New York City, July 24.

As the general principle of this apparatus is like the preceding, it is only necessary to say, that the arm which projects from, and is carried by, the piston rod for operating the valves, is attached to and carries the cylindrical rod, to which are attached tappets that act on the lower end of a trip lever, the upper end of which embraces the lever, or arm, of the slide valves; the lower end of the trip lever is provided with a roller that acts on a wedge piece kept up by a spring, so that the moment the roller has been forced over the angle of the wedge piece, the tension of the spring forces it entirely over, by which the complete action of the valves is insured, notwithstanding the engine may not complete its stroke.

Claim.—"What I claim as new, is the manner in which I govern

the action of the slide valve of the auxiliary engine, by the aid of the tappets, the vibrating piece, (trip lever) the sliding (wedge) piece, and their appendages, as set forth ; I claim the so regulating of this action, whether the apparatus be constructed precisely in the form represented, or in any other in which a like effect is produced, by means substantially the same."

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35. For an improvement in the mode of *Setting Logs on the Carriage of a Saw-Mill ;* Waterman B. Palmer, Brookfield, Madison county, New York, July 24.

For the general principle of the mode of setting logs, described in the specification of this patent, the reader is referred to the notice given of a patent granted to Henry Stanton, on the 16th of this month, (July,) number 26 of this list, the present patent having been granted for a combination and arrangement of parts for operating the long shaft that forms the connexion between the slides on the head and tail blocks. The claim refers to and is wholly dependent on the drawings, and therefore we are under the necessity of omitting it.

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36. For an improvement in the *Paddle-Wheels of Steamboats, &c.;* Richard D. Chatterton, Derby, Great Britain, July 24: to run fourteen years from the 11th of January, 1842, the date of the British patent.

This is for an alleged improvement on that kind of side paddle wheels in which the paddles, or floats, are placed at an angle with the shaft, as fully explained in the following—

Claim.—"I declare that what I claim as of my invention in paddle wheels of steamboats, and all other vessels, machines, or bodies which are propelled, or moved, by the action of floats, or other like contrivances, in and against water, in oblique positions relatively to the shafts, or axes, and in series of pairs in oblique directions the reverse of one another; is the placing of the inner extremity of each of the individual paddles, or floats, so as to project beyond the inner termination of the one opposite thereto, and said inner extremities being at such distances from each other as to admit of the passage of water between them. I do not claim the use of pairs of floats, or paddles, inclined towards each other, when such pairs meet and form an angular point, this having been often done; but I limit my claim to the particular arrangement of such pairs of floats, or paddles, as herein set forth, but without confining myself to the precise angles, or relative distances at which the floats are represented to be fixed, and reserving to myself a right to place them at any more suitable angles, or distances, by which the like beneficial results may be obtained."

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37. For an improvement in the *Bolter for Flouring Mills ;* Ryburn Buchanan, Sullivan county, Tennessee, July 24.

Claim.—"What I claim as my invention, is the combination with

the bolting reel of the long, vibrating, re-acting knocker, or knockers, suspended within the reel, and acting, when in operation, upon the arms of the same from one side to the other of the same, and reacting when revolved to the opposite side, so as to keep the bolting cloth clear of dust, as described, without injury to the cloth, and preventing its slipping on the ribs of the bolter."

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38. For improvements in machinery for making *Wrought-Iron Spikes, or Nails;* S. G. Reynolds, of Bristol, Rhode Island, now residing in Cecil street, Strand, Westminster, England, July 26.

The claims under this patent refer throughout to, and are wholly dependent upon, the drawings, which are very numerous, and we are, therefore, under the necessity of omitting them.

The nails, or spikes, are made in this machine by cutting from a plate, instead of a rod, as heretofore; the piece after being cut off from the plate, is griped and held against the die, by which it was severed from the plate, which becomes the bed against which it is rolled into the required form by a roller. After the operations of cutting and rolling, the head is struck, and the point formed by appropriate dies.

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39. For a machine for *Trimming the Blanks in the manufacture of Butt Hinges;* Cyrus Kenney, Troy, Renssalaer county, New York, July 26.

"The butt hinges that are to be manufactured by the aid of my machine, are such as are formed from wrought-iron, or other malleable metal. In the manufacture of such hinges the flaps, or halves, of the hinge are first cut out of rolled, or sheet, metal, with the pieces projecting from one side thereof, which, when bent, are to form the knuckles of the hinges, this cutting being effected in a manner well known. In the process of bending the knuckles formed from the projecting pieces, these become elongated, so that the two sides, or halves, of the hinge will not come together until reduced to the width they had before being bent. The machine covered by this is intended to remove this difficulty by cutting, or trimming, off a small portion from the sides of the projecting pieces, before they are bent, and made into knuckles." For this purpose there are gauges that fit between the projecting pieces before being trimmed, attached to the under part of the trimming cutters, or dies, operated by a lever, and acting against bed dies which aid in shearing off the surplus metal. The dies and gauges are regulated by set screws.

Claim.—"What I claim is the manner of arranging and combining the dies and gauges substantially as described and set forth in the specification."

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40. For improvements in machinery for making *Barrels, Firkins, &c.;* Horace Baker, McLean, Tompkins county, N. York, July 30.

After the staves have been shaved in the usual way, they are

clamped in a curved bed attached to a swinging frame, the centre of vibration of which corresponds with the centre of the barrel, and by means of this swinging frame they are presented, first, to a circular saw, which cuts off the surplus wood, and then to a straight reciprocating jointer. After this operation all the staves for a barrel are put together between two circular plates, on a lathe, with teeth for holding them firmly, and then turned off by means of cutters attached to a stock which slides transversely on a carriage that moves from end to end on ways; the stock being so arranged as to embrace a guide of a curve corresponding with the bilge of the barrel.

Claim.—"What I claim is the employment of the swing frame constructed and arranged as described, in combination with the edging and jointing machines, in the manner and for the purpose specified. I also claim the method of holding the staves for turning, in combination with the movable, double-motion, cutter carriage, arranged and constructed as before specified."

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41. For an improvement in the *Silk Reel for Reeling Silk;* James S. Harris, Poultney, Rutland county, Vermont, July 30.

"To prevent any injury to the silk upon the reel by undue tension, and to facilitate the removal of the silk from the reel," one arm is connected with the hub by a spring and slide.

Claim.—"What I claim is the spring graduated by the screw, in combination with the sliding arm of the reel, constructed and operating as described."

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42. For an improvement in the manner of *Constructing large Wrought-Iron Cannon;* Richard F. Loper, Philadelphia, Pennsylvania, July 30.

Claim.—"I am aware that it has been proposed to make large guns of staves and hoops, but not like those constructed by me. I do not, therefore, claim simply making guns of hoops, or rings, and staves, but what I do claim as my invention, and desire to secure by letters patent, is making guns by uniting the rings of each layer by screwing them into each other, and also by screwing other layers, or tiers, on to the first, second, third, and so on to any extent, as described."

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43. For improvements in *Fire Arms;* Edward Savage, and Simeon North, Middletown, Middlesex county, Connecticut, July 30.

This is for an alleged improvement in the mode of constructing guns, &c., that load at the breech, by making the breech part of the barrel separate and movable, the back part of this section turning on a joint pin in a socket, that the forward part may be thrown up sufficiently to receive the charge, and consists in a mode of insuring the coincidence of the movable section with the permanent part of the barrel, after being charged, and an arrangement of parts for giving the requisite movements. On each side of the movable section there is a strap, one of which is cut out to receive a shoulder, (called in the

specification a permanent chock,) on the side of the movable section, and the other adapted to receive the joint pin, or spindle, of a tumbler that embraces a circular projection on the other side of the movable breech, so that by the turning of this tumbler it is thrown up, or down; the spindle of the tumbler being provided with a hand lever, one end of which is cam-formed, and acted upon by a spring, to insure the complete movement of the parts.

Claim.—"What we claim is the combination of the tumbler chock with the receiver, (breech) in the manner and for the purpose set forth. We also claim, in combination therewith, the permanent chock, constructed and arranged as set forth. We also claim the lever and spring, in combination with the tumbler, chock, and receiver, arranged substantially in the manner and for the purpose described."

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44. For a *Rotary Printing Press;* Richard M. Hoe, New York City, July 30.

We make the following extract from the specification, viz.,—"The distinguishing feature of this press, is its being provided with a number of cylinders, say from two to six, or eight, or more, each of which is to receive a sheet of paper that is to be carried by it to the form of types to receive an impression. The whole of these cylinders are to be carried round, by the continuous motion, in one direction, of an axis which is their common centre of motion; or the cylinders may be attached to one or two chains, or bands, in a manner similar to that of the inking rollers, the form of type remaining at rest during the whole operation, so that the reciprocating action of the platen, or bed, or any other part having considerable momentum, is avoided." The journals of the cylinders are so arranged and connected with this common central axis as to slide towards and from it, and have a horizontal movement in passing over the form of type, and give the required impression. The practical application of this general principle, with the adaptation of all the details necessary to the operation of printing, is fully described and represented in the specification and drawings, and claim is made to the general character stated above, and to many of the details, but as the claim refers to the drawings, the publication of which would carry us beyond the limits of this work, we are under the necessity of omitting them; the reader will, however, from the above, be able to form a pretty clear notion of this novel and ingenious device.

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*Improvements added to existing Letters Patent during the month of July,* 1844.

1. For improvements in *Boxes for Railroad Carriages;* John H. Tims, Newark, New Jersey, July 1.

This is for an improvement added to letters patent granted to Mr. Tims on the 31st of October, 1839, and noticed in 2d series of this Journal, vol. xxvi, page 394, to which the reader is referred.

Claim.—"What I claim is the employment of two caps, or washers,

provided with packing between them, in combination with the grooved ring, by which arrangement the dust is effectually kept out of the oil box, and the oil kept in, as described, and this I claim as an improvement on the method employed by me heretofore, and secured to me by letters patent, and consisting of a single washer and grooves on the axle."

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*Patents for Designs which issued in the month of July*, 1844, *under the third section of the Act of August* 29, 1842.

For *Ornaments to be cast, or stamped, upon iron, or other plates, used in the construction of Stoves;* Amaziah Whitney, Albany, New York, July 19.

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## MECHANICS, PHYSICS, AND CHEMISTRY.

*Notice of the Manufacture of Glass in Bohemia. By* M. L. P. DEBETTE.—[Annales des Mines, 4th series, volume iv, page 553; December, 1843.]

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

(Continued from Page 122.)

CHAPTER IV.—*Manufacture of Table Glass and Fine Glass.*

As soon as the glass of the preceding casting has been worked up, each crucible is charged with about 154 lbs. of materials previously fritted, taking care to put the arsenic first, at the bottom of the crucible. This mixture varies, in a very notable degree, in different establishments, as may be seen from the following table:

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Pulverized quartz, | 110 | 100 | 80 | 60 | 120 | 100 | 120 | 120 | 100 |
| Superfine calcined potash, | | | | | | 30 | 60 | 70 | 55 |
| Fine " " | 64 | | 28 | | 60 | | | | |
| Common " " | | | | 60 | | | | | |
| Carbonate of potassa, | | 75 | | | | | | | |
| Caustic lime, | 24 | 50 | 18 | 24 | 25 | 18 | | 10 | |
| Carbonate of lime, | | | | | | | 24 | | 8 |
| Arsenious acid, | | | $\frac{1}{4}$ | 2 | $\frac{1}{2}$ | | | $\frac{1}{2}$ | |
| Peroxide of manganese, | | | $\frac{1}{4}$ | | 2 | | $\frac{1}{16}$ | $\frac{1}{8}$ | $\frac{1}{4}$ |
| Nitre, | | | $\frac{1}{4}$ | | 2 | | 2 | 1 | |
| Old glass broken and sifted, | | | | | | | | | 50 |

(1) White table glass, first quality, from Schwarzthal, a little white arsenic, and a very little peroxide of manganese are added.

(2) White table glass, from Neuwelt, (M. Perdonnet,) a small quantity of nitre, oxide of manganese, and white arsenic are added.

(3) Very white table glass (M. Penhok.)

(4) Common table glass (M. Hermbstädt.)

(6) (7) (8) (9) Fine glass, called Bohemian crystal, from various establishments. To (6) (7) and (9) a little white arsenic is added.

As soon as the glass pots are charged, the fire is increased by putting a very little more wood frequently upon the grate; gradually the mixture contained in the glass pots melts, and soon very small bubbles of gas begin to be disengaged from the midst of the fluid mass; the temperature of the furnace is continuously raised, and from time to time the melted mass is stirred with a piece of wood, in order to facilitate the disengagement of the bubbles which gradually augment in size. The workman judges that the fusion is nearly completed when the bubbles are formed but rarely, and of large size. He then ceases to stir the fluid mass, and suffers it to rest for a full hour, the fire being suffered to fall slightly, so that the glass may take sufficient consistency to be worked. The melting is then finished, and the working, properly so called, commences. Each melting pot is then served by a blower, (blaser) and an apprentice, (lehrjunge) as we have already said. The iron tubes which they use are nearly five feet (1.5 metre) long, weigh from 8½ to 11 pounds, and are provided with a handle of wood about 13 inches (33 centim:) long, to assist in the manipulation.

As the working of glass is a thing very difficult to explain, and one which must actually be seen in order to be well understood, I suppose that I may dispense with details upon this subject, feeling certain that in the remarks which I have to make I shall be understood by those who have studied the art of manufacturing glass.

The forms, or moulds, employed are generally made of two pieces, except in very particular cases where extremely simple articles are to be made, such as ordinary drinking glasses, to which a handle is often afterwards added, as in beer glasses, while the glass is still sufficiently soft to weld. These forms are of wood, clay, brass, or copper; those of cast-iron being not yet employed in Bohemia. Those most used are of wood, which the apprentice takes care to moisten very frequently, so as to prolong their duration by preventing them from taking fire.

In these arrangements it will be seen that there is no division of labor, and the same workman begins and finishes the pieces, so that the work is executed rather less rapidly than in France.

In fine, the melting of the glass lasts from 18 to 20 hours, the working, properly so called, from 14 to 15, making in all 32 to 35 hours for the whole operation. The loss by volatilization is from 15 to 20 per cent., and consists of water, carbonic acid, and alkali; there is obtained from 88 to 110 pounds per pot of finished glass, not including the loss, during the manipulation.

The annealing of the glass is performed by placing them, while still hot, in clay crucibles, 6-10ths of an inch in thickness, placed in the annealing furnace annexed to the melting furnace. The interior dimensions of these crucibles are as follows:—

| | |
|---|---|
| Diameter at the mouth, . . . | 15.68 inches. |
| " " bottom, . . . . | 15.68 " |
| Depth, . . . . . | 19.6 " |

When one of these crucibles is entirely filled, it is withdrawn by one of the doors of the furnaces, constructed for this purpose, and suffered to cool slowly in a corner of the establishment; the cooling being retarded as much as possible by covering it with a sheet-iron lid.

It may be easily seen how imperfect this process is, when compared with the constant annealing furnaces now in use in France, the use of which has not yet extended to Bohemia.

### Chapter V.—*Of the Manufacture of Bottle Glass.*

The bottle glass of Bohemia is very slightly colored, and would sell very badly in that country, if it had the deep green, or yellowish green color which our glasses present. In most of the glass establishments they make it by remelting old glass with that which runs out upon the hearth of the furnace when a pot breaks by age, or accident. In some other glass works, such as that of *Gross-Luckawitz*, near *Chrudim*, the bottle glass is made from a very friable quartz-oze sandstone, belonging to the *quader sandstein* formation of Bohemia, and sufficiently white for this purpose, from a very calcareous clay, a kind of tertiary marl, very recent, and very often covered with a formation of turf, and from glauber-salts, (sulphate of soda,) the residue from the preparation of nitric acid in the manufactory of chemicals established at the same spot, and belonging to the same proprietor, the Prince Auersperg. There is added besides these a certain quantity of charcoal dust to reduce the sulphate of soda. This establishment possesses but one circular glass furnace, containing six pots, the charge of each of which is about 177 pounds. The working season of this furnace is six months; the respite necessary for the repairs two months, and the blowers are not paid by the piece, as is the usual custom, but receive each one 1032 francs ($206.5) for the working season. They are besides exempt from all rent, or manorial dues, for the small portion of land which is allotted for their use.

The melting of the glass takes place exactly as I have described it in the preceding chapter. Then the blower takes upon the end of his tube a quantity of glass sufficient to form a bottle, by dipping it two or three times in the glass pot, and blows through the tube, which he turns, guiding it by a bar of iron, while the apprentice presses upon the glass a block of wood, which he dips in water from time to time, when he sees it take fire. Near the blower there is placed a tub full of water, from which he takes it from time to time in the hollow of his hand to cool his tube, when he finds it heat too much. When the piece becomes too cold, he reheats it, introducing it into the furnace by the opening which is above the glass pot, then resting his tube upon an iron hook which projects from the embrasure, he gives it a continuous motion of rotation, in order to prevent the glass from bending, or inclining, to either side. As soon as it has acquired nearly the desired form and size, he finishes it by placing it in a wooden mould, formed of two pieces, which is held by the apprentice, turning it, and blowing into it continually. Sometimes, however, a mould of a single piece is used, as is practised almost always in France, but

here far more rarely. The bottles have ordinarily their bottoms entirely flat.

As soon as the bottle has taken the desired form, the workman withdraws it from the mould, and his apprentice takes it by the bottom by means of a rod having a drop of melted glass upon it. The workman then detaches it from his tube, and forms the head by applying a cold body, or, in case of necessity, even by letting fall a drop of cold water upon the place which he wishes to cut. It is then slightly reheated by his apprentice, and a glass band wound around the neck to strengthen it. The bottle is then finished, and nothing remains but to transport it to the annealing furnace, which is sometimes joined to the melting furnace, sometimes separated, as at *Gross-Luckawitz*. In the latter case the furnace is kept at a dull red heat for four or five hours after it is full, then all the openings are closed, and it is left to cool spontaneously. To clean his tube, the workman dips it, while yet hot, into cold water, the glass at the end crumbles, and is detached by a single blow of a hammer.

To conclude, in the manufacture of bottle glass the melting lasts from 18 to 20 hours, the working 8 to 10 hours, in all from 26 to 30 hours.

## Chapter VI.—*Manufacture of Window Glass.*

The mixture employed for making window glass varies so to speak, in each establishment, as may easily be seen from the following table:—

| | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Pulverized quartz, | 60 | 60 | 60 | 100 |
| Fine calcined potassa, | | | | 50 |
| Common calcined potassa, | 40 | | 17 | |
| Common calcined soda, | | 36 | 17 | |
| Caustic lime, | | | 6 | |
| Carbonate of lime, | 5 | | | 80 |
| Debris from working glass, | 100 | 100 | } 120 | |
| Old broken glass, | 100 | 100 | } | |
| Nitre, | | | | 2 |
| Smaltz, | | | | $\frac{1}{12}$ |

(1) (2) Common window glass, (M. Penhok.)

(3) White window glass, from Schwarzthal and Paulina, near Gratzen.

(4) Very white window glass, (M. Hermbstädt.)

The melting of the glass offers nothing peculiar to arrest us. As soon as it is ended each blower takes upon the end of his tube a quantity of glass varying with the size and thickness of the sheet which is to be made, and blows it, swinging it in a vertical plane, so as to give it the form of an elevated cylinder terminated at each end by a hemispherical cap; he then gives it the desired dimensions in a wooden mould of one piece. He then separates the farther end by

the application of a cold iron, then reheats the piece, swinging it again, at the same time that he gives a rotary motion upon its axis to the pipe, and thus gives it the form of a cylinder, open at one end; he then separates it from his tube by means of a cold iron, or, if necessary, by a drop of cold water; he then cleans his tube, and recommences the same operation. The cylinders thus blown are slit throughout their whole length as soon as they are cool, by means of a red hot rod of iron. They are then introduced into the flattening kiln, (streckofen) by sliding them along two long iron rods, until they rest upon a plate of clay movable upon a railroad. There they are flattened by the heat, as the glass softens, and as soon as they are completely spread upon the plate of clay, these are slid upon the railroad into the annealing furnace, and then as soon as the glass is sufficiently cool to resist bending, the plates are gradually raised and rested upon rods of iron supported in grooves in the sides of the furnace. As soon as the annealing furnace is full, all the openings are closed, and it is suffered to cool slowly.

*Fluted Window Glass.*—Besides the plain window glass, they make, in Bohemia, a great deal which is fluted, either in one direction, or in two directions, making an angle of 30° or 45° with each other, presenting, in this case, the appearance of small consecutive lozenges. These glasses have the advantage of enabling us to dispense with window blinds and curtains, as they disperse the rays of the sun, so that they cannot produce inconvenience, and prevent any prying eye from looking into the room. The fluting of these glasses is effected during their blowing. For the glasses fluted in one direction only, it is sufficient to employ moulds of a single piece, either of wood, clay, or metals, and fluted in the direction of their length. The only difference in fluting them in two directions consists in the use of a more complicated mould, made of two pieces which are separated, in order to withdraw the cylinder.

*Elliptic Shades.*—The shades of clocks, &c., which have an elliptic form, are made also by moulding, but as they require a large quantity of air in blowing them, a peculiar process is used, invented in France by a workman in the establishment at Baccharach. This process consists in a hollow cylinder closed at one end, in which is fixed a spiral spring attached to a piston which moves in the cylinder. This is attached to the end of the tube, and the piston being suddenly forced down, all the air contained in the cylinder is driven out through the tube; the shade is then detached from the tube, and the open end finished by cutting.

## Chapter VII.— *Of some peculiar fabrics of Glass.*

*Manufacture of Glass Tubes with Circular Bores.*—To make cylindrical tubes the workman first blows a cylinder, as in the manufacture of window glass, except that he gives it greater thickness, and less internal diameter; then, after reheating it, his apprentice attaches another tube to the free end, by means of a drop of melted glass, and the cylinder is drawn out by their rapidly receding from each other. Nothing is then left except to divide the long tube, thus obtained, into

sections, and, to anneal these sections, the diameter and thickness of which depend upon the quantity of glass employed, the ratio of the external and internal diameter of the original cylinder, and the greater, or less extension which it has undergone.

*Manufacture of Glass Tubes with flattened Bores.*—For some years past capillary tubes, with flattened bores, have been much employed in the construction of mercurial thermometers, on account of their presenting the advantage of tubes, the section of which is very small, compared with that of the reservoir, while, at the same time, the mercurial column is very easily seen, when observed in a direction at right angles to the larger diameter of the section.

To make these, the workman takes upon his tube a certain mass of glass, without blowing it, and forms a sausage-shaped lump, which he presents to his apprentice, who seizes it at the end with a pair of small pincers held in one hand, whilst, with the other, he thrusts into it, in the direction of its length, a kind of double-edged knife, taking care to enlarge the opening, the other lip of which he immediately seizes with another pair of pincers, and draws it out by moving backwards, in a straight line, without turning the glass, as is done in a common tube. One-fourth, or one-eighth, of the tube, thus obtained, is fit for commerce; except that it very frequently happens that the bore is not exactly in the middle of the tube, which, however, is but a slight inconvenience, provided it be not far from it.

*Manufacture of Fine Glass (Crystal) by Moulding and Pressure.*—There are but few works in Bohemia which manufacture crystal by moulding and pressing, so that I shall have but very little to say upon the subject.

The principal establishment in which they employ this process is that of Winterberg, where they import from England and France the brass moulds employed, and the articles made are far inferior to the products of our establishments; this is owing, as I believe, principally to two causes:—

1st. That the Bohemian crystal is much less fusible and less fit for moulding than our lead glass.

2d. That in our best glass works the use of brass moulds is now almost entirely replaced by those of cast-iron, which, besides the advantage of lasting longer, are susceptible of a far finer polish, and upon the glass moulded in them, the striæ, so remarkable upon articles made in brass moulds, are scarcely to be seen.

*Manufacture of Watch Glasses.*—Hollow globes of glass are first blown of sizes and thicknesses varying with the convexity and thickness of the glasses required: a model glass is then laid upon the globe, and the red hot stem of a clay pipe is passed around its edge; the slightest shock is then sufficient to detach it, and it is finished by grinding.

## Chapter VIII.—*Of Colored Glass.*

Colored glasses are divided into those which are uniformly colored throughout, and those which are only colored in particular places.

To prepare the first, the coloring materials are introduced into the glass pot.

It is different in the second case, which is used especially for the more expensive colors, and those most difficult to procure, as well as in three operations peculiar to colored glasses, which consist, 1st, in making colored, or colorless, glass vessels with a foot of a different color; 2d, in making vessels with an interior very thin and very highly colored layer, and with an exterior of colorless glass, which may then be ground off in places without spoiling the uniformity of the tint; 3d, in forming the vessels in the opposite way, that is, an interior colorless layer, and an exterior more or less thick colored one, which is then ground off in places, so as to obtain a glass which presents all the shades of the color.

To obtain these results it is enough, in the first case, to solder the bottom of the vessel to a lump of colored glass fixed to the end of another tube, then to separate the first tube, and finish as usual; in the second case, the tube is dipped successively into pots of the colored and of the colorless glass; and in the third case, the operation is reversed.

As we have already said, there exist certain colored glasses which are not prepared in pots, but in rolls of very deep color, about 1.2 inch diameter, and a foot long. These are more fusible than the colorless glass, and are such that they melt at the temperature necessary for the complete fusion of 64 parts of colorless glass, and one of peroxide of manganese. When one of these rods is to be used, a piece of the proper size is broken off, fixed at the extremity of a tube, softened in the furnace, and worked as has been explained.

These preliminaries being settled, I pass to the description of the different matters which are used to color glass.

*Ruby.*—The manufacture of this color, which is extremely difficult to prepare, and is employed only in roll, is still involved in some obscurity. All the establishments which I have visited obtain their color from the manufactory of M. Meyer, at Stubenbach, near Berg-Reichenstein. According to a manufacturer of the Riesengebirge, the glass which they use for preparing the cakes of ruby color, (which bears the name of schmelze,) is composed of silica 500, minium 800, nitre 100, calcined potassa 100. A solution of gold is then prepared by treating 10 grammes* of fine gold with 180 aqua regia, by the aid of heat; when all is dissolved the liquid is poured into a vessel holding about a quart, which is then filled up with aqua regia. It is then poured into a second graduated vessel, and five times its bulk of water added. When this is done, they mix intimately 512 of schmelze, 48 of prismatic borax, 3 oxide of tin, 3 oxide of antimony, reduced to very fine powders, and $\frac{1}{80}$ of the solution prepared as above.

The whole is then heated for 12 or 14 hours in an open crucible, placed in a glass furnace, and then suffered to cool in an annealing oven. When it is cool they break the crucible, and take out the color. It is not necessary to use closed crucibles, as some manufacturers assert.

If more acid is used than is prescribed above, the crucible is attacked, but the color is more solid.

* The French gramme is equivalent to 15.438 grains troy.

The purple of Cassius is only mechanically mixed in the glass, and if this be remelted it often becomes dull, and striæ are formed, which are nothing more than extremely fine particles of reduced gold. In certain cases the quantity of oxide of tin used in the above mixture must be from 2 to 4 parts. The first of these mixtures is used especially for large pieces which have to be worked a long time in the fire; the second, for small and delicate articles. Nevertheless, as the process does not always succeed, the greater part of the manufacturers prefer, as I have said, to buy the color ready made from other manufacturers, who devote themselves exclusively to this. The antimony appears, in this case, merely to give brilliancy to the glass without coloring it at all.

According to the director of one of the glass works in the neighborhood of those of Bohemia, a very beautiful ruby color may be obtained in the following way:—Dissolve by heat one gramme (15.4 grains troy,) of fine gold in an aqua regia composed as follows,—12 grammes nitric acid, 12 grammes muriatic acid, and 1 gramme sal ammoniac. Again, dissolve by heat 1 gramme of tin, in an aqua regia composed of 20 grammes nitric acid, and 6 muriatic acid; then pour the two solutions into a large vessel containing already 500 grammes of clear water, and mix them intimately by agitating the vessel after corking it. The red precipitate of purple of Cassius, which forms, is washed and dried with care. A peculiar glass is then prepared by mixing together 40 parts of very pure quartz pulverized, 16 parts of nitre, 8 parts of borax, 1 part of white arsenic, 1 part of cream of tartar, finely pulverized and sifted through silk; and a greater, or less, quantity of the purple of cassius, according as you want a more, or less, deep color. This mixture is introduced into a clay crucible made expressly, not glazed, and of about the capacity of 5 quarts, or else in an ordinary glass pot, then heated in a glass furnace, or in a small furnace made expressly for it, taking care to stir the materials continually until they have attained a dull red heat. The crucible is then covered, and the heat continued for some time. When the mass is perfectly melted, and gives no more bubbles, the crucible is removed, and after suffering it to cool for 4 or 5 hours in a cellar, it is broken, and the glass obtained separated with care from the impurities which it may contain; it is then ground and sifted. If now there be melted together in a small crucible placed in the glass furnace, the following mixture:—128 parts of pure quartz pulverized, 64 parts of nitre, 3 parts of borax, and 3 parts of white arsenic; and the glass thus obtained poured into cold water, then ground, and passed through a sieve, then mixed with the colored glass prepared as above, and melted in a glass crucible, a glass will be obtained, which, worked up into articles of a thickness not exceeding 0.16 to 0.2 inch, takes a beautiful ruby color when exposed to the smoke obtained from burning fir, or that of alder.

*Bohemian Ruby-Red*—They prepare besides, in Bohemia, a peculiar ruby color, which is also employed in cakes, and has received the name of *Bohemian Ruby.* It is prepared by melting together quartz powdered and fritted 100, minium 150, potassa fritted 30, borax fritted 20, sulphuret of antimony 5, peroxide of manganese 5, ful-

minating gold rubbed in with oil of turpentine 5. If a little more fulminating gold is used a magnificent ruby color is obtained.

Fulminating gold is obtained by precipitating the solution of gold in aqua regia by ammonia, and stirring the liquid for some time. The precipitate is then collected upon a filter, and washed rapidly with water boiled, and rendered slightly ammoniacal, then dried at a very low temperature. There is thus obtained a powder of a deep brownish yellow, very explosive, and of which the manipulation requires great precaution.

*Ancient Red called Kirschroth (cherry red.)*—This color is generally employed in cake; it is procured by the use of sub-oxide of copper, which is kept in the state of sub-oxide by the addition of an equal quantity of protoxide of tin. When it is desired to pass the color to a fiery red, a little oxide of iron is added. The proportion of oxide of tin must then be reduced, and it may entirely disappear, as in a very beautiful antique red glass, found at Caprea, in the villa of the emperor Tiberius, the analysis of which gave,

| | |
|---|---|
| Silica, . . . | 71. |
| Protoxide of Lead, . | 14. |
| Suboxide of Copper, . | 7.5 |
| Peroxide of Iron, . | 1, |
| Alumina, . . . | 2.5 |
| Lime, . . . . | 1.5 |
| | 97.5 |

Sometimes the glass is merely colored with the oxide of copper, and then after the articles are finished they are smoked, which gives them a deep red color.

*Blue.*—The azure blue color is obtained by the oxide of copper alone, cobalt blue by the oxide of cobalt, or smalts.

*Amethystine Violet.*—This color is obtained by the oxide of manganese, mixed with a little nitre.

*Yellow.*—There are five distinct yellows which are prepared as follows:—

1. *Topaz Yellow.*—Prepared with charcoal dust.

2. *Antimony Yellow.*—Prepared with a mixture of glass of antimony and minium.

3. *Orange Yellow.*—Prepared with glass of antimony, minium, and a little oxide of iron.

4. *A peculiar Yellow.*—Very expensive, which is prepared with chloride of silver, and is only applied in a very thin layer, as a sort of enamel, the glass must then be smoked, in order to make the color appear.

5. *Greenish Yellow.*—Which produces a fine effect in day light, but which appears of a dirty yellowish white by the light of a lamp, or candle. This yellow is prepared with the yellow oxide of uranium of commerce, but since this last contains traces of iron, the yellow glass obtained presents almost always a light green tint upon its edges.

*Green.*—There are four distinct greens:—

1. *Grass Green.*—Which is obtained by the oxide of chrome, or a mixture of glass of antimony and oxide of cobalt.

2. *Bottle Green.*—Prepared with protoxide of iron.

3. *Ancient Emerald Green.*—Prepared with oxide of copper mixed with a small quantity of finery cinders.

4. *Modern Emerald Geeen.*—This color, which is far more beautiful than the preceding, is prepared with a mixture of oxides of nickel and uranium.

*Black*—Is prepared with peroxide of manganese, oxide of copper, oxide of cobalt, in equal parts; or else with a mixture of finery cinders, peroxide of iron, oxide of copper, or cobalt.

*Hyacinth.*—The hyacinthine color is obtained with a large quantity of red oxide of iron, and the oxide of nickel.

To be Continued.

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## *On the Chemical Reactions produced by bodies which intervene only by contact.* *By* E. Mitscherlich, (Ann. de Ch.)

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Whatever length of time hydrogen and oxygen gases may be left in a state of mixture with each other, they never combine, even in the presence of such bodies as sulphuric acid, potash, or lime, which have a great affinity for water, and which, it would seem, ought to provoke its formation. If, however, metallic platina be immersed in a mixture of these gases, their combination is instantly produced on the surface of the metal.

We may mix these gases in the proportions which constitute water, and in a very short time the hydrogen and oxygen are so distinctly diffused, that each molecule of the one finds itself in presence of a molecule of the other; and since the molecules of gaseous bodies possess an excessive mobility, and as their cohesion is not an obstacle to their combination, as in the case of solid and liquid bodies; and since also we may suppose that the affinity of hydrogen and oxygen in water is equivalent to a pressure of many thousand atmospheres, it must be at once admitted that besides the ordinary forces (raisons) which oppose chemical combination, there is another which prevents the combination of hydrogen and oxygen by neutralizing their natural affinity.

Some bodies in a state of solution act among themselves in the same manner as hydrogen and oxygen, with regard to platina. We may abandon, for a long time, an aqueous solution of cane sugar without perceiving any alteration in it; but if we add to it dilute sulphuric acid, the sugar, without combining with the sulphuric acid, solidifies a portion of water, and is transformed into glucose. The decomposition of gaseous ammonia by incandescent copper, is one of the (not very numerous) examples in which the decomposition of a gaseous body is promoted by a solid body: we have, on the contrary,

numerous examples of decompositions of this kind among liquid and solid bodies, which undergo themselves no change during the reaction;—the decomposition, for example, of the binoxide of hydrogen under the influence of various bodies,—the decomposition of chlorate of potash by the oxide of copper, and other fixed bases.

Before we undertake to ascertain why certain chemical reactions take place under the influence of bodies which interfere with each other only by their presence, we must seek to give an account of the manner with which bodies that do not combine chemically, act upon each other when placed in immediate contact.

We may show with the greatest facility the attraction which a solid exerts upon a gaseous body, by employing the first in a condition in which it presents the greatest possible surface under the smallest volume, as in very thin leaves, or better, in impalpable powder. Charcoal, and many substances of difficult fusibility, like platina, which may be obtained in a state of extreme tenuity, are very suitable for these experiments.

I have calculated, in the first volume of my *Traité de Chimie*, the amount of surface in one cubic inch, divided into little cubes of $\frac{1}{2400}$ of an inch on each side, by two series of perpendicular sections. It would be equal to 100 square feet, without estimating the extent of the interstices

If any substance be brought to such a state of tenuity that we may suppose it reduced to its atom, or, at least, to a degree of known approximation, we may then calculate the surface which it would represent.

The estimate may furnish the value of the greatest diameter of an atom of a chemical compound, when the latter is obtainable in the condition of thin plates, or of vesicules, by the colors which they present;—thus the diameter of an atom of water must be, at most, $\frac{1}{10000000}$ of an inch, according to the color which appears at the thinnest portion of a soap bubble.

In reducing a dilute solution of chloride of platina, by means of carbonate of soda, and formic or tartaric acid;—or in decomposing very dilute sulphate of platina by weak alcohol, the metallic platina obtained in either case must be in the state of molecules, since the molecules, at the moment of reduction, are separated by water, which necessarily prevents their agglomeration.

A volume of one cubic inch filled with globules, which we will suppose, for the sake of facility, to have only $\frac{1}{10000000}$ of an inch diameter, but placed in such a manner that the lines passing through their centres be perpendicular, or parallel, to each other, will present a surface of 218,166 square feet. In any other position the surface would be still greater if the globules touched each other. It is possible that platina black has a surface as considerable.

Wood charcoal is the most convenient substance for studying the action of large surfaces on gases, and the experiments of De Saussure, are, on this account, very important. Vegetable fibre does not melt when properly heated, so that the charcoal resulting from its calcination, still preserves the form of the fibre, as we may readily convince

ourselves, by placing the transverse section of a carbonized branch under the microscope. We discover every little cell of the plant, and we may assure ourselves that the form of the partitions have remained intact.

The cells of wood charcoal have, as a medium, a diameter of $\frac{1}{2400}$ of an inch; their surface would be equal, therefore, to 100 square feet, if the charcoal itself occupied no space. I prepared some wood charcoal, which weighed .9565 grains, and after boiling it some time in pure water, and wiping simply the surface of it, its weight was 2.2585 grains; its weight under water was .110 grains; the space into which the water had penetrated, and, consequently, into which elastic fluid might have penetrated after the expulsion of the latter, constituted then $\frac{3}{4}$ of the total volume of the charcoal; in reckoning the space occupied by the charcoal itself, we find that the extent of its surface is only 73 square feet. De Saussure found that wood charcoal absorbs 35 times its volume of carbonic acid at the temperature of 12 degrees, and under a pressure of 26.895; but 35 volumes of carbonic acid is found in a space which constitutes $\frac{3}{4}$ths of the total volume of the charcoal, and, consequently, 56 times smaller than the space originally occupied by the carbonic acid.

Agreeably to the experiments of Addami, carbonic acid is liquified under a pressure of 36.7 atmospheres, at a temperature of 12 degrees. We are thence led to conclude that more than one-third of the carbonic acid which is condensed in the pores of the charcoal, is in a liquid state on the sides of the cells.

If 35 cubic inches of carbonic acid are condensed on a surface of 73 square feet, or 10,512 square inches, the thickness of the layer of liquid carbonic acid on the sides of the cells must be .000002 of an inch. This stratum is thicker when the experiment is made with ammoniacal gas, chlorhydric acid, or sulphurous acid, which do not require so enormous a pressure for liquefaction, and which are absorbed in more considerable quantities. Since all porous bodies, in presenting to the gas a considerable surface, act in the same manner as charcoal, we must admit that the gases which are in contact with solid bodies are in a peculiar state, and different from that in which they are when isolated from them; and moreover since the thickness of the layer of condensed gas varies, attraction is exerted not only on the gas which is in immediate contact with the solid body; it acts at variable distances. But porous bodies do not act at their surface only, for if it were so, the absorption of different gases by different substances ought to be in the same proportion. It is not thus, since, according to Saussure, wood condenses proportionally more carbonic acid than charcoal; also asbestos, spongy quartz, cotton, and silk tissues absorb different gases in proportions varying from that of wood charcoal.

The absorbent power of pulverulent substances has been hitherto but very little studied. Platina black, prepared by the method of Davy, far surpasses all others: 10 grains condense .550 cubic inch of oxygen; that is to say, one cubic inch of it would condense 253.440 cubic inches, (Chimie de Platina, by Dobereiner, page 64;) but it is

impossible to decide what the volume is which platina takes up when it condenses oxygen, because it is in a state of powder. The property which certain bodies possess, like silex, of condensing the humidity of the air, authorizes us to conclude that they have an aptitude in condensing gases.

As solids attract gases, they are capable, in like manner, of exerting this attraction over solid bodies; thus we may, by means of charcoal, deprive alcohol of the potatoe oil which it holds in solution. In boiling charcoal with water, the oil passes, unaltered, to the latter; this force of attraction carries off solid coloring matters from liquids which hold them in solution.

Some precipitates have the property of attracting a portion of the soluble salts from the fluid around them; they entangle and remove them, but washing sets them free.

I dissolved some nitrate of barytes in 10 parts of water; after having precipitated about half of it by sulphuric acid, I determined the quantity of nitrate of barytes which was held by the clear supernatant fluid. The fluid liquid, arising from the washing of the precipitate, was evaporated, and the nitrate of barytes which it contained was determined.

In subtracting the weight of this nitrate, and the weight of the sulphate of barytes obtained from the total weight of the wet precipitate, the weight of the water contained in the liquid was arrived at. In calculating, from these data, on the one part, the weight of the nitrate of barytes in the liquid which overflowed the sulphate, and on the other part, that of the liquid which moistened the precipitate, it was found that two-thirds only of the latter was dissolved in it, and that the one-third contained in the water used in washing must have been condensed by the attraction exerted by the precipitated sulphate. If, instead of precipitating a solution of barytes, we employ the chloride of barium, the latter is thus drawn away. But if we precipitate a solution of nitrate and sulphate of soda, by nitrate of barytes, and wash the precipitate until a drop of the washing leaves no trace of solid matter on a platina blade, it happens, in this case, that the sulphate of barytes may retain as much as two per cent. of nitrate of soda; to remove it the precipitate must be calcined, and then washed.

The sulphate of barytes, therefore, exerts an attraction so weak on the chloride of barium as to be unable to remove it from its aqueous solution; but with respect to the nitrate, the attraction is so strong as to render a great quantity of water necessary to clear it; but water is incapable of removing completely, from sulphate of barytes, the nitrate of soda which it retains at the moment of its formation.

One may very easily judge of the force of attraction which solid bodies exert upon each other by considering the action of cement upon wood and glass. If we cover a plate of glass with moist bladder, and, when dry, try to detach it, we tear off portions of glass. The action of the bladder upon the glass is stronger, therefore, than the cohesion of molecules of the glass itself; but if we allow the plate of glass and bladder to remain some time in boiling water, the gelatine is dissolved, and the bladder is easily removed.

Although this attraction is very strong, it is less considerable than that of sulphate of barytes for nitrate of soda. The attraction which solid bodies have for liquids and gases is manifest not only by immediate contact, but also at a determinable distance. We may prove it by using plates of glass, or of quartz, having two perfectly smooth faces. The first is to be suspended, and the other furnished with the means of attaching weights. I deprived two plates, thus disposed, of all adhering humidity; the thinnest layer of it interposed, shows itself by the production of the colored rings of Newton. By compressing these plates afterwards, until the colored rings begin to appear, we may easily determine their distance. At the appearance of the second ring, the lower plate, whose weight was 14 grammes, remained attached to the first. The contiguous surfaces were but one inch square; when pressed together, so that the black appeared over nearly the whole of the first ring, several pounds might be suspended from it. By having this apparatus for some time under the air pump, the plates did not separate, so that atmospheric pressure was not the cause of their adherence.

We know that this kind of attraction takes place generally during the crystalization of bodies. A body dissolved deposites itself on threads, or solid bodies, suspended in the liquid, much quicker than if these are not present. Crystals are formed much faster around a crystal already formed than in any other portion of the liquid, when, for example, the force of the solvent is lessened by a diminution of its temperature. The solvent force of water is, therefore, less energetic near a formed crystal than at a certain distance from it.

In some cases it is easy to account for the chemical combinations which the action of solid bodies on liquids and gases may excite, but in others the explanation becomes more difficult. It is possible that condensation alone may be the cause of it in gaseous bodies. We may, in this way, very well explain the distinction which M. Thenard observed, on introducing charcoal into a mixture of sulphhydric acid and oxygen. When platina black, which has condensed oxygen, is placed in contact with chlorhydric acid, there results, according to Dobereiner, chloride of platina. We know that, in this case, the condensed oxygen may readily seize the hydrogen of the acid; and yet the affinity of chlorine for platina interferes in the case. The affinity of gold for chlorine provokes the decomposition of nitric acid by chlorhydric acid, when leaves of gold are placed in aqua regia, since the latter contains free chlorine only after it has been warmed, or after being for a long time left to itself.

When a gas is in the nascent state, a phenomenon is presented analogous to those just mentioned; the gas combines often with a body in contact with it, which, in other circumstances, would produce no action upon it. Thus, in the cases in which the chemical affinity of two gases is weak, it may happen that their condensation causes them chemically to combine.

Nevertheless it appears doubtful whether we ought to attribute the combination of two bodies, which, like oxygen and hydrogen, have so strong an affinity for each other, to the effects of condensation alone,

though we may be authorized to grant that in the various physical conditions of platina a condensation of gas takes place at its surface.

We know that in leaf and in fine wire, platina acts as well as in the precipitated, or spongy, state, or in black; but the combination is slower as the surface used is more limited.

The leaves and sponge of platina do not condense a large quantity of oxygen; but in comparing their surfaces with that of platina black, we perceive that it ought to be so. The sponge of platina arising from the decomposition of the double chloride of platina and potassium is formed at a temperature at which the mixture begins to agglomerate, and presents itself under the form of plates, which cannot certainly possess a surface large enough to admit of an easy appreciation of gaseous condensation.

An experiment first made by M. Fusinieri, and is easily repeated, proves that air and moisture are condensed on the surface of glass. If we pour into a glass tube boiled mercury, which has been cooled in a vacuum, we find that it gives out air, when heated, even when the precaution is taken to assure ourselves by the microscope, that no traces of it adhere to the sides of the glass; but if into a tube of glass which has been exposed to a high temperature, we pour mercury by means of a funnel whose point touches the bottom of the tube, and then heat the tube, not a bubble of air escapes, even when mercury is used which has been agitated with air and water, and left to dry by simple exposure to free air. The gaseous bubbles then which the mercury, in the first experiment, yielded, must have come from the air and moisture condensed on the sides of the tube; but the quantity of air and water, thus condensed, is so trifling, its presence can only be proved by such an experiment as above stated.

It would be impossible to prove the condensation of any gas whatever on the surface of platina leaves, even supposing it to be as considerable as that of the carbonic acid on the surface of charcoal.

A mixture of alcohol and oxygen act, in the presence of platina, absolutely in the same manner as a mixture of oxygen and hydrogen. Oxygen is devoid of action on weak, or concentrated, alcohol. Platina black provokes their combination. Other bodies also do the same. It has been thought that to effect this reunion it was necessary to recur to the use of ferments; but M. Duflos has proved that chips of wood, soaked in acetic acid, act in a manner analogous to platina black. One might have supposed that the acetic acid thus used had deposited some ferment on the wood; but these ferments would soon have been decomposed by the oxygen of the air, and M. Duflos has proved that with chips, or shavings, alone, we may transform alcohol into acetic acid for months together.

When acetic acid is prepared by exposing beer, or fermented liquors of this kind, to the action of air, they become turbid, and deposit matters of an organic nature. These spongy matters, acting after the manner of platina black, will condense oxygen, and thus determine the combination of these bodies.

**To be Continued.**

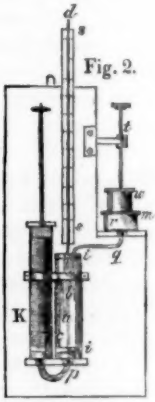
***On a Voluimnimeter.*** *By* M. HERMANN KOPP.—Ann. de Chimié, from Ann. des Mines.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

I have given this name to a new instrument which may readily serve to determine the volume of any substance, solid, or liquid, and thus furnish the density of various bodies for which the ordinary methods are insufficient.

Fig. 3.

Fig. 2.




The instrument is constructed in the following manner:—K, fig. 2, is a pump in which moves a solid piston; this pump communicates below by means of a bent tube *p*, with a cylinder *i i*, the upper part of which is closed, and pierced by two tubes *c d*, and *i q*. The straight tube *c d*, open at both ends, is prolonged upwards, and fitted with an arbitrary scale, the zero of which is at a short distance from the cylinder. The tube *i q*, bent as in the figure, enters the bottom of the cylindrical vessel *r*, the vertical parts of which are represented in fig. 3. At the upper part of the same cylinder *i*, *i*, are fixed several platina points *a b*, . . . . of different lengths.

The vessel *r*, contains another vessel *w*, in which is placed the body to be subjected to the experiment. A disk *m m*, compressed by means of a screw *t*, and of an elastic body *u*, hermetically closes the vessel *r*, the borders of which are worked for this purpose. The pump K, the tube *p*, and the lower part of the cylinder *i i*, are to be filled with mercury.

Thus arranged, let *x*, be the volume of air enclosed in the cylinder *i i*, commencing at *c*, in the vessel *r*, and in the tube of communication *i q*. Let *y*, be the quantity by which the volume will be diminished by lowering the piston so as to bring the mercury in contact with the point *a*, and let B, be the common height of the barometer, we shall have, for the height of the column of mercury in *c d*, $\frac{y}{x-y}$ B, the measurable height, and which I will suppose equal to $\frac{1}{n}$ B; *n*, having been accurately determined, once for all, for the same point *a*. We shall then have $y = \frac{1}{n+1}\, x$.

If now we introduce into the capsule *n*, a body of known volume *z*, and compress it to the extent of the volume *y*, we shall have, in designating by *h* B, the new height of the column of mercury in the tube *c*, *d*:

$$\frac{\frac{x}{n+1}}{(x-z)-\frac{x}{x+1}}\,\mathrm{B} = h\,\mathrm{B}.$$

Whence,

$$x = \frac{(n+1)h}{hn-1} z;$$

from which the value of $x$ is determined, once for all, for the same instruments.

Then, if we wish to determine the volume of any body $z$, we subject it to experiment like the body $z$, and we have, in designating by $h, b$, the weight of the mercury $c, d$, for the body $z$:

$$x = \frac{(n+1)h}{hn-1} z;$$

and on this occasion $x$ being known, we deduce from it the value of $z$.

The instrument is provided with several points of platina, so that various experiments may be made on the same bodies which control each other, and allow of an accurate mean.

The following are results obtained by this instrument, which, agreeing well with results directly obtained, enable us to place confidence in its indications.

| Names of Substances. | Density obtained by the Voluminimeter. | Density by common method. |
|---|---|---|
| Lead, | 11.404 | 11.373 |
| Tin, | 7.363 | 7.38 |
| Sal Ammoniac, | 1.50 | 1.45 Wollaston<br>1.53 Mohs.. |
| Chloride of Sodium, | 2.15 | 2.08 Harslen.<br>2.26 Mohs. |

This coincidence induced me to employ the voluminimeter for determining the density of various substances, which the methods commonly employed could not accomplish. The following are my results:—

| Names. | Density. | Names. | Density. |
|---|---|---|---|
| Pumice stone, | 2.15 | wood of linden, | 1.13 |
| Ashes of beech, | 2.85 | " fir, | 1.16 |
| Wheat flour | 1.49 | " walnut, | 1.17 |
| Starch, | 1.56 | " apple tree, | 1.20 |
| Flax, (for spinning,) | 1.46 | " plumb, | 1.23 |
| Silk, (from cocoon,) | 1.55 | " pear, | 1.23 |
| Cotton, | 1.27 | " oak, | 1.27 |
| Wool, | 1.29 | " beech, | 1.29 |
| Cork, | .33 | | |

The several woods experimented upon were reduced to powder by rasping, and dried at a temperature of about 100 degrees.

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*On a new shortened portable Barometer. By* HERMANN KOPP.—Ann. des Mines: (Ann. de Ch. t. vi.)

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

The instrument which I am about to describe, and which appears to be worthy the attention of philosophers and intelligent travelers, is

constructed on this principle:—"If a like volume of air in different states of condensation be compressed by a like quantity, and be at liberty to act on a column of mercury, this column will rise in proportion to the density of the compressed air before compression."

It is composed of two cylinders in their glass K, and *i i* communicating at the lower part by means of a bent tube *p*. In the cylinder K, is a solid piston. The cylinder *i i* is closed at its upper part, except that this part is traversed by a tube *c d* open at both ends. The body of the pump K, and the tube *p*, are filled with mercury, which, when the piston is at the highest point of its course, rises a few lines in the cylinder *i i* so as to leave the lower end of the tube *c d* open, which thus puts the air of the cylinder into communication with the atmosphere. To the tube *c d* there is adapted a platina wire whose two extremities, pointed and blackened, are fixed as *a* and *b*. On the same tube *c d* is traced an arbitrary scale whose zero is a little above, at a known and invariable distance from the points *a* and *b*.

Thus arranged, if the piston in K be depressed, the mercury will rise in *i i* will soon close the opening *c*, and then will compress the air in the cylinder. The piston is to be brought down until the mercury rises to *a*, for example. This compression will raise the mercury in the tube *c d* and from the height of this column, easily estimated by adding to the length indicated by the scale, the invariable distance from the point *a*, to the zero of this scale, the pressure of the atmosphere may be deduced.

To do this it will be sufficient to have determined by some previous trials, the constant relation which subsists, under the same circumstances, between the height of the common normal barometer, and that of the barometer now in question. This relation is determined by taking the mean of the relations of a certain number of observations made simultaneously with the two instruments; and when, on occasion, we wish to bring the heights given by the new barometer to the common barometric heights, we multiply them by this constant coefficient.

It is needless to say that at each observation the barometer must be placed vertically, and left to acquire an equilibrium of temperature with the ambiant air.

The second point *b*, serves to render the instrument double, so to speak, in order to make an experiment controling the former. The constant coefficient must, in this case, have been previously determined for that point.

A condition essentially needful in the construction of the instruments, is that the highest point *b*, must never be so high that the mercury, in reaching it, will rise in the tube higher than the upper part of the scale, and yet that it must come near it in order to profit by the whole length of the scale. The position which this point should occupy is easily determined. Let L be the length *c d*, D, the distance from *b* to *c*, then for the greatest possible barometric height

H, we have $D+\frac{D}{L-D}H<L$; (L D and H estimated by the same measure.)

This instrument, easily used, and, above all, easily and conveniently carried, has served me during a five months' journey. I subjected it to all sorts of trials, with respect to its solidity and invariability, and I am convinced that it gives barometric pressures with an error less than half a line, and more commonly with still greater exactness, although it is seldom more than 25 centimetres in height.

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*Memoir on a New Process of Chlorometry.* By M. LASSAIGNE, (Compte Rendu de l'Acc.)

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

This process appears to me worthy of all preference to the chlorometer with an indigo test, by the unchangeableness of the proof liquor made use of, and by the exact and constant results which it furnishes. It rests on the precise knowledge of the proportion of any gaseous chlorine which is sufficient to decompose a determinate weight of pure ioduret of potassium, in order to become transformed entirely into chloride of potassium, and perchloride of iodine, both of them compounds soluble in water: the decomposition of this ioduret is easily marked by a small quantity of solution of starch, which, added to portions of ioduret at the moment of pouring in the chloric solution, gives immediately and successively the blue, violet, green, red, and yellow colors, as long as the smallest portion of free iodine remains. As soon as the decomposition is complete, the decolored liquor resumes the transparency and limpidity of distilled water;—this reaction enables us to appreciate the change much better than when we operate with the sulphuric solution of indigo, which, we know, remains always of a reddish yellow, more or less deep at the precise period of completing the test.

An equivalent of pure, dissolved, ioduret of potassium, requires, for its complete decomposition, six exquivalents of dry chlorine. The result is one equivalent of chloride of potassium, and one equivalent of perchloride of iodine $ICh^5$. From these data one litre of dry gaseous chlorine at a pressure of .76 m., weighing 3.208 grs., decomposes 2.482 grs. of ioduret of potassium.

Therefore, in dissolving this quantity of ioduret of potassium in a litre of distilled water, a normal solution is prepared which requires for its total decomposition a volume equal to its own, of dry, gaseous, chlorine. For the operation we put into a glass vessel a measured quantity of the solution, and add to it a small quantity of solution of starch, (prepared by dissolving a gramme of starch in a hundred grammes of warm water, and filtering it when cold, or by rubbing in an agate mortar some dry starch, and treating it with 100 parts of cold water.) Put the starch solution into the crust with a bent neck, usually employed in chlorometric assays, and add it drop by drop to

the given solution of ioduret, mingled with starch solution, and stop at the moment in which the liquid, after passing through all the shades mentioned, becomes extremely clear. The quantities of chloric solution are in inverse ratio with the proportions of chlorine which they contain. The only precaution necessary in the assay, is to hold in the left hand the glass which contains the measured ioduret charged with eight or ten drops of starch solution, and twirling it round a little, pour into it from the right hand the chlorated solution contained in the crusts.

The determination of the value of an alkaline hypochlorite is effected in the same way in operating upon a recent solution of the salts made in the proportion of ten grammes to a litre of water. One condition only it is important to observe, in order that the operation be quickly and accurately performed; that is, to add to the test solution, charged with starch, a drop or two of concentrated sulphuric acid, for the purpose of disengaging chlorine, when the solution of hypochlorite is added. If this be not attended to, the operation is slow, and requires repeated additions, for to the coloring and discoloring produced by the first drops of hypochlorite in the non-acidulated proof liquor, succeeds spontaneously a fresh coloration which is soon destroyed by a few drops of hypochlorite, and this effect continues four or five times in succession, until the ioduret of potassium is decomposed.—*Ann. des Mines*, tom. iii, liv. 11.

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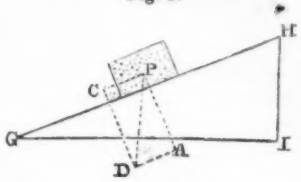
FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*On the Diameter of Screws.* By JAMES DEAN, A.M., A.A.S., &c., and late Prof. Nat. Phil. and Ast. Univ. Vt.; investigated in 1825.

Every attentive student must have been surprised, on his first examining the investigation of the mechanical powers, at finding that the *diameter* of the screw was not an element in expressing the ratio of the power to the weight necessary to produce an equilibrium; and that, other things being equal, the diameter of the cylinder may vary *ad infinitum*, without, in the least, affecting that ratio. That reducing, or increasing, the diameter to an extreme degree, the distance of the threads remaining the same, will diminish the effect of any given power, will be universally admitted without any very nice reasoning on the subject; but it seems far from useless to ascertain the *exact* diameter, which, under any given circumstances, will enable a given power to produce the greatest effect, and it is very natural to look among the effects of friction for this as well as other deviations from abstract theory. Now the ratio of the friction to the pressure which produces it, has been found by Amontons, Parent, Coulomb, &c., to be very nearly constant between the same surfaces, and commonly about one-third. And as the writer cannot learn that friction is much considered in this country as a retarding and computable force, he takes the liberty of translating from Bossut's Mechanics, those sections in which he treats of friction as affecting inclined planes.

269. Let a body P, be placed on an inclined plane whose length is G H, height H I, and base G I; resolve the weight of the body, represented by the vertical line P D, into two other forces P C parallel, and P A perpendicular, to the inclined plane. It is obvious that the force $PC = P \times \frac{HI}{GH}$, and the force $PA = P \times \frac{GI}{GH}$. The first of these two forces, called the relative weight of the body, tends to make it slide down the plane, while the second produces a pressure on the plane, and causes a friction of the first species, so that putting $n$, for the ratio of the pressure, the friction $= n\,P \times \frac{GI}{GH}$. If, therefore, the body be left entirely to itself, it will not descend unless its relative weight P C, be greater than the friction, that is, unless $\frac{P \times HI}{GH} > n\,P \times \frac{GI}{GH}$, or $HI > n \times GI$.

Fig. 1.




Hence, a body laid on an inclined plane, and left to the action of its weight only, will not descend unless the height of the plane is greater than the product of the base multiplied by the ratio of the friction to the pressure.

270. Let a body be ready to descend, or let its relative weight be equal to the resistance of friction $HI = n \times GI$, or $n = \frac{HI}{GI}$. Thus, when the inclination of the plane is such that a body may be ready to descend by its own relative weight, the ratio of the friction to the pressure is that of the height of the plane to its base. Knowing, therefore, either of these ratios the other is known also.

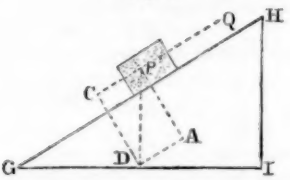
Suppose, for example, the friction to be one-third of the pressure $\frac{HI}{GI} = \frac{1}{3}$, and by trigonometry the ratio $\frac{HI}{GI}$ may be considered as that of the tangent of the angle of inclination H G I to radius, and by trigonometric tables, this last ratio being $\frac{1}{3}$, the angle H G I is about 18° 26'. So that the friction being taken at one-third of the pressure, the angle of inclination of the plane must be about 18° 26', that the body may be on the point of descending by its own relative weight.

If, on the contrary, the angle of the inclination of the plane be given, the ratio may be found by the tables, which is the value of $n$. This furnishes a very simple and convenient method of ascertaining friction by experiment. It is only necessary to lay the body on a plane at first very little inclined to the horizon, and gradually increase the inclination until the body begins to descend, and the ratio of height of the plane to its base is that of the friction to the pressure.

271. We will now consider a body which some power is ready to raise along an inclined plane, by overcoming its relative weight and friction. It is easy to find the general value of that power, but we shall confine ourselves to the two cases which most frequently occur,

viz., when the direction of the power is parallel to the length of the plane, or to its base. The one method may easily be extended to every other case.

Fig. 2.

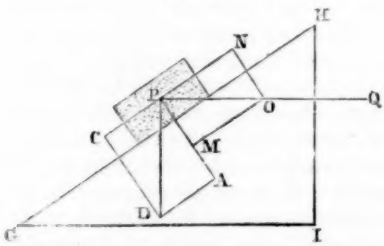



272. In the first place, let the power Q, act in a direction parallel to the length of the plane. In order that the body may begin to slide in the direction G H, the force Q, must be equal to the sum of the relative weight of the body and the friction. But in constructing, as above, the rectangle P A D C, and always calling $n$, the ratio of the friction to the pressure, the force, or relative weight, $PC = P \times \frac{HI}{GH}$, the force $PA = P \times \frac{GI}{GH}$, the friction $= n\,P \times \frac{GI}{GH}$; and, therefore, $Q = P \times \frac{HI}{GH} + n\,P \times \frac{GI}{GH}$, a formula which exhibits the quantity by which the friction enters into the expression of the power Q.

*Example.*—Let the weight P = 8000 lbs., the angle of inclination H G I = 30°, or $\frac{HI}{GH} = \frac{1}{2}$, $\frac{GI}{GH} = \frac{1.73}{2} = 0.866$, very near, and $n = \frac{1}{3}$, then Q = 4000 lbs. + 2309.4. The power Q must, therefore, be more than 6309.4, while without friction it would be only 4000 lbs.

273. In the second place, let the power Q act in the direction parallel to the base of the inclined plane. Having resolved, as above, the weight of the body into two forces P C, and P A, the one parallel, the other perpendicular, to the inclined plane, resolve in like manner

Fig. 3.




the power Q, expressed by the part P O, of its direction, into two other forces P N, and P M, the one parallel, the other perpendicular, to the length of the plane. Then the force,

$$PC = P \times \frac{HI}{GH},\ PA = P \times \frac{GI}{GH},\ PN = Q \times \frac{GI}{GH},\ \text{and}\ PM = Q \times \frac{HI}{GH}.$$

The whole pressure on the inclined plane being equal to the sum of the two forces P A, P M, if $n$ always represents the ratio of the friction to the pressure, it is plain that the friction,

$$= n \times \left( P \times \frac{G\,I}{G\,H} + Q \times \frac{H\,I}{G\,H} \right)$$

This being premised, in order that a body may be ready to slide in the direction G H, the force P N must be equal to the sum of the force P C, and the friction, or

$$\frac{Q \times GI}{G\,H} = \frac{P \times HI}{G\,H} + n \times \left( \frac{P \times GI}{G\,H} + \frac{Q \times HI}{G\,H} \right),$$

whence,

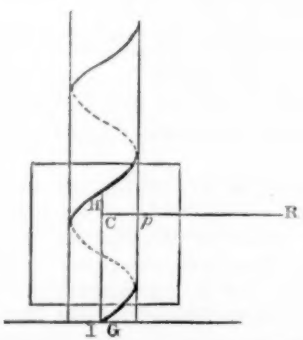
$$Q = P \times \frac{H\,I + n \times G\,I}{G\,I - n \times H\,I}.$$

Without friction the value of the power would be $\frac{P \times H\,I}{G\,I}$, so that $\frac{P \times (H\,I + n \times GI)}{G\,I - n \times H\,I} - \frac{P \times H\,I}{G\,I}$, or $\frac{n P \times \overline{G\,H^2}}{\overline{G\,I^2} - n \times G\,I \times H\,I}$, is the quantity by which the friction increases the power.

*Example.*—Let P = 8000, H G I = 30°, or $\frac{H\,I}{G\,H} = \frac{1}{2}$, $\frac{G\,I}{G\,H} = \frac{\sqrt{3}}{2}$ = .866, $n = \frac{1}{3}$. It will be found that Q = almost 9021.7 lbs. Without friction the power would be only about 4618.8 lbs.

*Of Friction in the Screw.*

Fig. 4.




Let the inclined plane G H I, expressing the last value of Q in the above paragraph, as the power in the screw always acts in a direction parallel to G I, or perpendicular to the axis of the cylinder, be wrapped round a cylinder of such radius C $p$, that G I, the base of the triangle, shall be just equal to the circumference, and, of course, just reach round it; and let G H, the inclined plane itself, be produced in the *same direction* an indefinite number of turns around the cylinder. Here then obviously G H, forms one thread of a screw, while H I, the height of the inclined plane, is equal to the distance of the threads

parallel to the axis. Then let a nut be perforated, and formed in the interior, so as to correspond to the thread of the screw, applying itself to the surface G H, in its whole length, and perhaps two or three other turns, and let the weight P be laid on the nut, the friction is the same whether it be supported on a small, or large, surface, and let this nut be furnished with a lever C R, perpendicular to the axis, and extending to R, the point where the new power $q$, is applied, make an equilibrium with the weight P, and its friction in the same manner as Q does at the surface of the screw. On the principle of the lever, $q : Q :: C\,p : C\,R$, or $q = Q \times \frac{C\,p}{C\,R}$. Let this equation be incorporated with that expressing the value of Q in the inclined plane, where the power acts in a direction parallel to the base, and we shall have $q = P \times \frac{C\,p \times (H\,I + n \times G\,I)}{C\,R \times (G\,I - n \times H\,I)}$. This is the formula for the screw as commonly constructed; P = the weight to be raised, $q$ = the power necessary to just not produce motion when acting at the distance C R, and in a plane perpendicular to the axis C, $C\,p$ = the semi-diameter of the screw, H I = the distance of the threads measured parallel to the axis, G I = the circumference of the screw, $n$ = the ratio of the friction to the pressure.

Now, in order to find the value of C $p$, when $q$ is a minimum, the other quantities remaining constant, P and C R being omitted, as affecting all the terms equally, for conciseness' sake let $C\,p = x$, $H\,I = h$, and $\pi = 6.28$, &c., and the fraction will become $\frac{hx + n\pi x^2}{\pi x - hn}$, which has its least value when its differential,

$$\frac{h\pi x dx + 2n\pi^2 x^2 dx - h^2 n dx - 2hn^2 \pi x dx - h\pi x dx - n\pi^2 x^2 dx}{\pi x - hn^2} = 0,$$

whence $\pi^2 x^2 - 2hn\pi x = h^2$ and $\pi x$, (the circumference of the screw,) $= h \times (n + \sqrt{1 + n^2})$ from which the diameter may be computed as usual.

From the denominator of the first fraction in the last paragraph, it appears that when $h\,n = \pi\,x$, that is, when the circumference of the screw : distance of the threads : : the friction : the pressure, the denominator becomes 0, and, therefore, the power $q$ must become infinite, or the effect 0. When this is the case, if $h$, or the perpendicular height of the inclined plane, formed by one revolution of the thread, be taken = 1, or radius, then $n = \pi x$ the circumference of the cylinder, or base of the plane, or cotangent of the angle contained between any thread and a plane perpendicular to the axis. Let $a$ represent this angle, then $n = \text{cot.}\ a = \frac{\text{cot.}^2 \frac{1}{2}\,a - 1}{2\ \text{cot.}\ \frac{1}{2}\,a}$ by an : trig : whence $\text{cot.}^2 \frac{1}{2} a - 1 = 2\,n\ \text{cot.}\ \frac{1}{2}\,a$, and $\text{cot.}\ \frac{1}{2}\,a = n + \sqrt{1 + n^2}$, which is precisely the value of the circumference given by the calculus when the effect is greatest, so that the angle of inclination at which the greatest effect is produced, is exactly half of that angle which, with the same degree of friction, is the limit of all effect.

From the calculus it appears that screws are commonly made much too large in proportion to the distance of the threads, to produce any given effect with the least power, the circumference in hardly any practical case being, for that purpose, greater than twice the distance of the threads, and the diameter much less than that distance. Thus, suppose it be desired to produce a pressure equal to ten tons, with a screw whose threads are one inch asunder, lever eight feet long, and friction one-third the pressure; if the screw be six inches in diameter, the power must exceed 275 lbs., if the diameter be only two inches, any power greater than 122 lbs., will be sufficient. If the friction amount to half the pressure, the dimensions still remaining unaltered, the powers corresponding to the same two diameters, will be 398 and 168 lbs. respectively. The least powers with these two degrees of friction would be 72 lbs. and 98 lbs., and require diameters only 0.4416 in., and 0.515 in. respectively; but no substance is known, which, when reduced to even twice these dimensions, would have strength enough to resist the torsion. It appears, therefore, that a screw, as an engine of force, with any given distance of thread, ought to be made as small as the strength of the material will admit.

In order to ascertain, by computation, the middle course between wasting materials, labor, and power, on one hand, and hazarding the failure of the machine on the other, we may adopt the doctrine "that in resisting torsion the whole lateral cohesion is exerted at $\frac{1}{4}$th the radius of the cylinder from the centre."* The notation of the formula for the screw being retained, and S being put for the lateral cohesion of a square unit of the substance used, the area of the section is $\frac{\pi x^2}{2}$, and its strength $\frac{S \pi x^2}{2}$, then $CR : \frac{x \,..\, S \pi x^2}{4 \,..\, 2} : \frac{S \pi x^3}{8CR}$ = the force of the cohesion at the end of the lever, which, being substituted for $q$, in the formula $\frac{S \pi x^3}{8CR} = \frac{P \times (hx + n \pi x^2)}{CR \times (\pi x - hn)}$, and this equation being reduced, gives $x^3 - \frac{hn}{\pi} x^2 - \frac{8Pn}{S\pi}, x = \frac{8Ph}{S\pi^2}$, in which, if the known quantities are properly substituted, the value of $x$ may be safely adopted as the radius of the cylinder.

But when the exertion of great force, or the weakness of the material, renders a large cylinder indispensable, the distance of the threads should be greater also, because increasing the distance of the threads does not require, by any means, a proportional increase of power. Thus with the six-inch cylinder, above mentioned, with the friction of one-third, increasing the distance of the threads from one to two inches, requires an increase of power less than one-sixth, viz., from 275 lbs. to 319 lbs.; and with a friction of one-half the increase is only one-eighth, or from 398 lbs. to 448 lbs., which may generally be compensated by using a longer lever, while the action will be much more prompt and rapid. And less than double the power will produce the same effect, though the distance of the threads be made

* Edin. Encycl. vol. v, p. 400; art. "Carpentry."

equal to the diameter of the screw, or six times their former distance. The reason of this will be obvious, when it is considered that in this case the whole power except 37 lbs. is employed in overcoming the friction, and that at such a small angle of elevation, the pressure, and, consequently, the friction, is but slightly varied by a variation of that angle. And with the same distance of the threads, if the diameter receive successive increments, the ratios of the corresponding powers will continually approximate to the corresponding ratios of the several diameters, because the effect of friction, which absorbs most of the power, is proportional to its distance from the fulcrum.

But after all it is far from being eligible, in practice, *always* to give screws the shape above described, especially in the fastening of instruments, or machines, where the object is not to produce but to prevent motion, because if the distance of the threads be greater than $n$ times the circumference, the friction of the screw will not prevent it from running back. On this account it may not be improper to investigate the figure of a screw so formed, that, without making the angle of ascent of the thread more acute than necessary, yet the friction shall always hold it where the power leaves it. Let it be required, therefore, so to shape a screw, that with any given degree of friction the power necessary to turn it forward shall have a ratio to the power necessary to turn it back equal to the ratio of the two given quantities $f : b$; $f$ being, of course, larger than $b$. As the length of the lever to which these powers are applied, cannot effect their ratio to each other, they may be considered as applied at the surface of the cylinder, and this surface may be further considered, as extended on a vertical plane, in which case one revolution of the thread is the length of an inclined plane, the circumference of the cylinder is its base, and the distance of the threads its height; reversing the course of reasoning adopted in the first two sentences of the description of the screw. Bossut, in Art. 273, as translated above, gives the force which, acting parallel to the base, (as it always does in the screw,) just balances the relative gravity, and the friction,

$$= \frac{P \times (HI + n \times GI)}{GI - n \times HI},$$

where P = weight, G I = base, H I = height, and $n$ = the ratio of the friction to the pressure. But in order to express the greatest force which, acting in the direction of the relative gravity, would not drag the body down the plane, H I in the preceding equation, must be taken with the contrary sign from what it is in the equation above, because the force P C, or $P\frac{HI}{GH}$, or relative gravity, instead of opposing the power, assists it, and the force P M, or $Q \times \frac{HI}{GH}$ reversed, instead of increasing, now diminishes the pressure which produces the friction, or resisting, force. With this change the greatest force which (acting parallel to the base, and from the summit towards the foot of the plane,) will not drag the body down the plane, will be found,

$$= \frac{P \times (-HI + n \times GI)}{GI + n \times HI}.$$

Let now H I = rad. = 1, $n$ = cot. $a$, as before, and G I = cot. $z$; $z$ being the angle at the base of the inclined plane, on which, with the given degree of friction, $n$, the force forward and backward will have the required ratio $f : b$. Then dividing by P, we shall have $f : b :: \frac{\cot.a \cdot \cot.z + 1}{\cot.z - \cot.a} : \frac{\cot.a \cdot \cot.z - 1}{\cot.z + \cot.a} :: \cot.(a - z) : \cot.(a + z) :: \sin.2a + \sin.2z : \sin.2a - \sin.2z$. Then by com. and div. $f + b : f - b :: \sin.2a : \sin.2z$, whence the base G I, or circumference of the screw, and thence its diameter may be easily found.

By the diameter of a screw is always meant the arithmetical mean between the greatest and least diameters of the bearing surface of the thread. The screw is also supposed to have a square thread, or at least that the section of its bearing surface with a plane passing through the axis, is a right line, and perpendicular to the axis. But when the thread is in the form of a triangular prism, or rather, when the section above mentioned makes an oblique angle with the axis, the pressure, and of course the friction is increased in the ratio of the sine of that angle to radius, so that $\frac{n}{\text{its sine}}$ must be taken instead of $n$, through the whole investigation. It is supposed also that there is no pressure except on the threads of the screw; in practice, however, there is almost always a pressure at the other extremity equal to the weight raised, or effect produced, and the increase of power required by the friction resulting from this pressure, is proportional to the mean distance of its action from the axis of the screw. In most of the instruments called vices, or rather wherever the screw acts by tension between the points of action, this pressure is distributed over a circular space surrounding the body of the screw, and the friction thus remote from the axis must absorb a considerable portion of the power; but in the presses, or where it acts by compression between the points of action, it is commonly confined to the extremity of a pivot, and its retarding effect must be comparatively trifling.

***Tables showing the results of the preceding investigation, the distance of the same thread after a complete revolution being the unity,*** C R = 100 in., P = 100 lbs.

TABLE I.—Showing the circumferences, diameters, radii, and angles of screws, and the proportional powers required for several different degrees of friction.

| Degrees of Friction. $n$ | Bases and Circumference. | Diameters | Radii. | Angle $a$. | > Min. pwr. | Least power. |
|---|---|---|---|---|---|---|
| 3 | $3+\sqrt{10}=6.1623$ | 1.9615 | .9808 | 18° 26′ | 9° 13′ | 6.0437 |
| 2 | $2+\sqrt{5}=4.236$ | 1.3484 | .6742 | 26 34 | 13 17 | 2.8559 |
| $1\frac{1}{3}$ | $\frac{4+\sqrt{25}}{3}=3$ | .9549 | .4774 | 36 52 | 18 26 | 1.4433 |
| 1 | $1+\sqrt{2}=2.4142$ | .7684 | .3842 | 45 0 | 22 30 | .9276 |
| $\frac{3}{4}$ | $\frac{3+\sqrt{25}}{4}=2$ | .6366 | .3183 | 53 8 | 26 34 | .6369 |
| $\frac{1}{2}$ | $\frac{1+\sqrt{5}}{2}=1.618$ | .515 | .2575 | 63 26 | 31 43 | .416672 |
| $\frac{1}{3}$ | $\frac{1+\sqrt{19}}{3}=1.3874$ | .4416 | .2208 | 71 34 | 35 47 | .306365 |
| $\frac{1}{4}$ | $\frac{1+\sqrt{17}}{4}=1.2808$ | .4076 | .2038 | 75 58 | 37 59 | .261075 |
| $\frac{1}{5}$ | $\frac{1+\sqrt{26}}{5}=1.2198$ | .3883 | .1941 | 78 41 | 39 21 | .2368 |
| $\frac{1}{6}$ | $\frac{1+\sqrt{37}}{6}=1.1805$ | .3758 | .1879 | 80 32 | 40 16 | .2218 |

TABLE II.—Giving the power for several diameters under each degree of friction, and showing that the diameter given by the formula and the preceding table requires the least power.

| Several Degrees of Friction. | | | | Several Degrees of Friction. | | | |
|---|---|---|---|---|---|---|---|
| | $n$ | Diameters. | Powers. | | $n$ | Diameters. | Powers. |
| | 3 | 2 | 6.04582 | | $\frac{1}{2}$ | 3 | .96 |
| | | 1.9615 | 6.04368252 | | | 2 | .7161 |
| | | 1.96 | 6.043686 | | | .52 | .416689 |
| | | 1.92 | 6.04636 | | | .515 | .416672 |
| | | | | | | .51 | .416691 |
| | 2 | 2 | 2.9339 | | $\frac{1}{3}$ | 3 | .68 |
| | | 1.36 | 2.8561 | | | 2 | .52 |
| | | 1.3484 | 2.8559 | | | .4418 | .3063647 |
| | | 1.34 | 2.856 | | | .4916 | .3063646 |
| | | | | | | .4414 | .3063647 |
| | $1\frac{1}{2}$ | 2 | 1.9167 | | $\frac{1}{4}$ | 2 | .4261 |
| | | .96 | 1.43242 | | | .42 | .26113 |
| | | .9549 | 1.432391 | | | .4076 | .26107 |
| | | .95 | 1.43242 | | | .4 | .26110 |
| | 1 | 2 | 1.3785 | | $\frac{1}{5}$ | 2 | .371 |
| | | .78 | .927765 | | | .4 | .23684 |
| | | .7684 | .92762 | | | .3883 | .23680 |
| | | .76 | .92770 | | | .38 | .23683 |
| | $\frac{3}{4}$ | 2 | 1.0032 | | $\frac{1}{6}$ | 2 | .3347 |
| | | .64 | .63663 | | | .38 | .221784 |
| | | .6366 | .63662 | | | .3758 | .221779 |
| | | .63 | .63666 | | | .37 | .221789 |

TABLE III.—Which, for the several degrees of friction, shows the diameters of the screws, and the angles of the threads necessary to insure a given ratio between the powers requisite to turn the screw forward and backward.

| Different Degrees of Friction. | Proportion of Forces Forward and Backward. | | | | |
|---|---|---|---|---|---|
| $n$ | 3 : 2 | 2 : 1 | 3 : 1 | 4 : 1 | 5 : 1 |
| | 5·285. 3° 27′<br>3·74 : 2.49 | 3·152. 5° 46′ | 2·073· 8° 44′<br>5.85 : 1·95 | 1·709. 10° 33′ | 1·525. 11° 47′<br>8·57 : 1.72 |
| 2 | 3·953. 4° 36′ | 2·345. 7° 44′ | 1·525. 11° 47′ | 1·245. 14° 21′<br>4·619 : 1·55 | 1·102. 16° 7′ |
| $1\frac{1}{2}$ | 3·285. 5° 32′ | 1·937. 9° 20′ | 1·245. 14° 21′ | 1·004. 17° 35′ | ·88. 19° 54′ |
| 1 | 3·051. 5° 46′<br>1·224 : ·816 | 1·855. 9° 44′ | 1·188. 15° 0′<br>1·732 : ·577 | ·955. 18° 26′ | ·833. 20° 54′<br>2·235 : ·447 |
| $\frac{3}{4}$ | 3·285. 5° 32′ | 1·937. 9° 20′ | 1.245. 14° 21′ | 1·004. 17° 35′ | ·88. 19° 54′ |
| $\frac{1}{2}$ | 3·953. 4° 36′ | 2·345. 7° 44′<br>·682 : ·341 | 1·525. 11° 47′ | 1·245. 14° 21′ | 1·102. 16° 7′ |
| $\frac{1}{3}$ | 5·285. 3° 27′<br>·402 : ·268 | 3.152. 5° 46′ | 2.073. 8° 44′<br>·513 : ·171 | 1·709. 10° 33′ | 1·525. 11° 47′<br>·582 : ·186 |
| $\frac{1}{4}$ | 6·750. 2° 42′ | 4·033. 4° 31′ | 2.668. 6° 48′ | 2·209. 8° 12′ | 1·978. 9° 9′ |
| $\frac{1}{5}$ | 8·264. 2° 12′ | 4·945. 3° 41′ | 3·28· 5° 33′ | 2·721. 6° 40′ | 2·441. 7° 26′ |
| $\frac{1}{6}$ | 9·804. 1° 52′<br>·2 : ·167 | 5·872. 3° 6′ | 4·91. 4° 40′<br>·252 : ·084 | 3·24. 5° 37′ | 2·91· 6° 15′<br>·281 : ·056 |

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

## *Wire Ropes on the Inclined Planes of the Allegheny Portage Railroad.*

Last year we called the attention of our readers to the successful application of *wire ropes* upon our State railway, crossing the Allegheny mountains. It gives us pleasure to have occasion to add further evidence of their utility, and of their superiority over *hemp ropes*, for the service of inclined planes, whether in point of durability, of efficacy, or of economy. With these remarks, we invite attention to the following extract from the report of John Snodgrass, superintendent of the Allegheny Portage Railroad, to the Canal Commissioners of Pennsylvania, dated December 9th, 1844.

COM. PUB.

"*Ropes for Inclined Planes.*—There are *eight* planes on the Portage Railroad on which hemp ropes are in use, and *two* on which wire ropes are placed."—"*The wire rope on plane No.* 3, has now been running for more than two seasons. At present it exhibits some evidence of 'wear.' However, this rope labored under very considerable disadvantage when first placed on the planes. It being altogether an experiment, it was not supposed that the machinery could be perfected at once. For the first two months before the introduction of the double-grooved receiving sheeve, and while the small iron sheeves were on the plane the injury to the rope from friction was greater than that sustained ever since; the double grooved receiving sheeve, and small *wooden* sheeves having been substituted for those formerly in use, '*the wear and tear*' since has been comparatively small. For what length of time it may yet be competent for the service of the plane is somewhat uncertain; *yet enough has been already ascertained to establish the fact, that wire ropes are much superior to hemp ropes, owing to their greater durability, and the evident economy of their introduction.*"

"*The wire rope on plane No.* 10, was introduced at the commencement of business last spring; it has been in constant use ever since, and at present presents very little injury from wear and tear. I am inclined to believe that this rope will last for at least *three* business seasons, and perhaps for a longer period."

"The principal objection heretofore urged against the substitution of wire ropes for hemp ropes, has been the necessary expense to be incurred in rebuilding foundations of stationary engines. As by the directions of the Board the foundations of the engines at planes Nos. 1 and 6, which, at present, are worked with hemp ropes, will be rebuilt during the present winter; and as the foundation of plane No. 2, was rebuilt last winter, it appears to me advisable to procure wire ropes for said planes."

"The following calculation of the relative cost of *hemp* and *wire* ropes must prove most conclusively the advantage of the introduction of the latter. I take it for granted that a good wire cable will be all sufficient to do the business of any plane on the road for a term of

*three* years—probably much longer. Experience has shown that the average durability of hemp ropes is not more than for *one* season. The hemp rope now on plane No. 6, weighed 2.81 pounds to the foot run, which, at 15 cents per pound, makes the cost 42.15 cents per foot. Now Mr. Rœbling proposes to furnish a wire rope, made of No. 14½ wire. (such as is now on plane No. 10,) at 51 cents per foot; or a rope made of No. 10 wire, at 37 cents per foot."

"Presuming the foregoing data to be correct, it will give the following result:—

| | |
|---|---|
| "For 5,826 feet of *hemp rope*, per season, at 15 cents per pound, ($2,455.65) or, for *three* seasons, | $7,366.95 |
| "For 5,826 feet of *wire rope*, (which will most certainly last *three* seasons,) at 51 cents per pound, | 2,971.26 |
| "Saved by the substitution of wire rope on *one* plane, | $4,395.69 |

"Or $1,465.23 per annum.

"There are yet *eight* planes worked with *hemp ropes*, requiring 41,779 feet of rope. The foregoing statement shows an annual saving, by the introduction of *wire ropes*, of $1,456.23 for every 5,826 feet; (the length of rope required for plane No. 6,) or 25.14 cents per foot. *This will give an entire annual saving, by placing wire ropes on the eight remaining planes, of* $10.503.24."

"One objection heretofore urged against the use of wire ropes on planes, has been the difficulty of attaching cars with safety to the main rope, and also the large number of hemp stops worn out in hitching to it. These objections *have been entirely overcome* by the substitution of an 'iron stop,' invented by John Little, pattern maker in the Johnstown depot. This '*stop*' is a most excellent invention, and its adoption in place of the hemp stops will be a safeguard against any accident in consequence of the '*hitch*' slipping."

"There is a decided advantage in passing cars with wire ropes over and above the economy spoken of, and that is the facility with which cars can be passed in wet weather. The double-grooved receiving sheeves afford sufficient adhesion to draw up any amount of burthen to which the stationary engine power is adequate, while, at certain times, the hemp ropes and single-grooved receiving sheeves are almost useless. My judgment approves of the suggestions made in reference to *wire ropes*, and I am induced to embrace this opportunity of presenting them to the consideration of the Board of Canal Commissioners."

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FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

*Modification in the manner of Working Air-Pumps.* By O. Keese.

The following is a sketch of a modification in the manner of working air-pumps, which occurred to me a few days since. It may, very possibly, be in use already; but as I am not aware of its being used, and as it appears to me to combine advantages not found in the com-

mon method of rack and pinion, and presuming that it might perhaps be of use to some of your readers, (in case the method is not already known,) I venture to forward to you a description of it. The modification consists in the use of crank and connecting rod, as shown at A A, fig. 1 and 2, instead of rack and pinion, as in the common air-pump. Across the upper part of the piston rods *b b*, are guide pieces *e e*, which move, with the piston rods, up and down in grooves formed in the upright posts D D D, and keep the piston rods perpendicular.

Fig. 1.

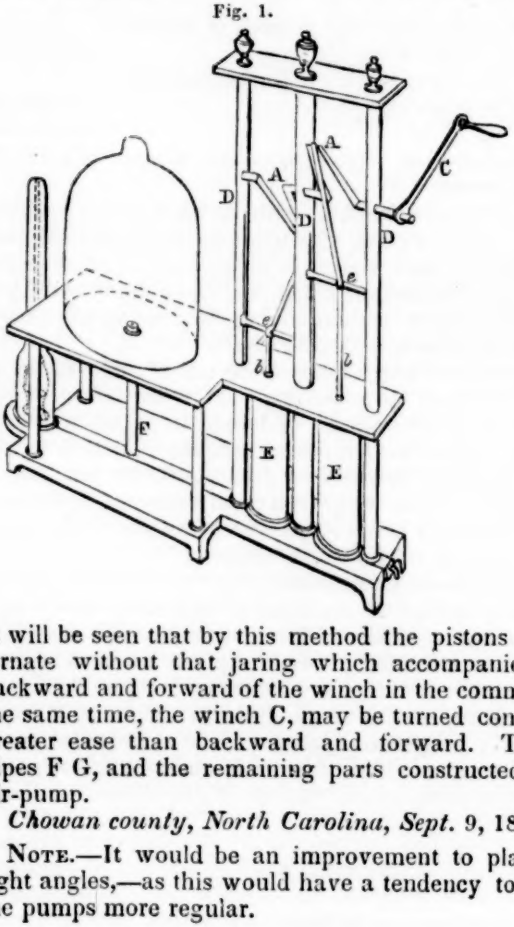
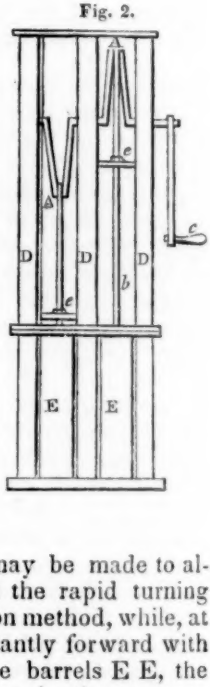



Fig. 2.




It will be seen that by this method the pistons may be made to alternate without that jaring which accompanies the rapid turning backward and forward of the winch in the common method, while, at the same time, the winch C, may be turned constantly forward with greater ease than backward and forward. The barrels E E, the pipes F G, and the remaining parts constructed as in the common air-pump.

*Chowan county, North Carolina, Sept.* 9, 1844.

NOTE.—It would be an improvement to place the two cranks at right angles,—as this would have a tendency to make the action of the pumps more regular. COM. PUB.

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### *Improvements in Sub-Marine Blasting at Spithead.*

Lieut. Barlow, the present executive engineer officer at Spithead, who conducts the operations with no less zeal, intelligence, and activity, than his able predecessors, has tried numerous experiments in

the firing of gunpowder by the voltaic battery, partly with the service charges used in breaking up the timbers of the wreck, in tin cans not usually exceeding from 44 lbs. to 55 lbs. of gunpowder, and partly with small experimental charges of a few ounces, by desire of Gen. Pasley, who wished to carry out Lieut. Hutchinson's ingenious plan of firing submarine charges by one conducting wire only, instead of two, (see *Journal*, vol. vi, p. 337,) using the water of the sea to complete the electric circuit. In these experiments Lieut. Barlow first found that it was unnecessary to let down a piece of wire with zinc plates attached to it from the voltaic battery into the water, as had been done by Lieut. Hutchinson, for the circuit was equally good when the wire alone was used; and on repeating those experiments in Gen. Pasley's presence, the correctness of this principle was sufficiently proved, but a difficulty occurred which had not been experienced before, viz., that it required two plate batteries of ten cells each, to fire a charge at a distance of 200 feet, with the single wire, whereas one of Prof. Daniell's batteries of eight cells only, which is inferior in power to a plate battery of ten cells, had always fired submarine charges instantaneously in former years by the double wire, which circumstances had not been adverted to by Lieut. Barlow, as this was his first season. Gen. Pasley, therefore, concluded that the firing charges with one conducting wire, instead of two, might diminish the power of voltaic electricity more than had been suspected last year, when this change was introduced so very late in the season, that there was not time to investigate the result of it in all its bearings; and, consequently, he directed that two conducting wires on reels, the same that had failed in igniting a charge when attached singly to less than a twenty cell plate battery, should be attached to one plate battery of ten cells, on the original principle used at Chatham and Spithead, from 1838 to the middle of 1843 inclusive, so that these two wires, well insulated, connected that battery and a charge at the bottom, without trusting to the water. On adopting this arrangement, instantaneous explosion took place as soon as the circuit was completed. Thus the double metallic circuit was proved to be the best for firing gunpowder, whether underground, or under water, and will as such be exclusively used in all future explosions; though for the purposes of an electric telegraph, which requires wires to be laid for many miles, and which needs infinitely less power than is necessary for the firing of gunpowder, water, or moist earth, especially the former, may be used to advantage for completing the circuit, in combination with one wire only, extending the whole length of the telegraphic line. Civ. Eng. & Arc. Journ.

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TRANSLATIONS FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

## *Solar Tides.*

Extract of a letter from *Mr. Airy* to *Mr. Miller*.—"I beg you to present my best compliments to M. Arago, and to inform him that I have discovered a position on the west coast of Ireland, where the

solar tide is greater than the lunar, although upon each side of this peculiar locality the solar is (as usual,) the smaller tide. This position is near a *node*, and the place of the node is not the same for the solar and lunar tides. A six-hour tide, *(marèe quarto-diurne,)* which shows itself perceptibly in my discussion of all the tides of the environs, is not influenced by this node, and, consequently, becomes, under ordinary circumstances, the most striking phenomenon; taking all things into consideration, it is the strangest thing that I have ever seen.

Compte Rendus des Seances de l' Academie des Sciences, 16 Sept., 1844.

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### *Printing in Colors by the Typographic Process.*

M. Silbermann, a printer at Strasbourg, presented several specimens of printing in colors, obtained by the aid of the ordinary typographic press. One of these specimens is taken from an impression of two thousand five hundred copies, "all of which," says the author of the letter, "are perfectly identical with each other; and, after leaving the press, required no re-touching." This little picture, which presents twelve different colors, was printed by means of a single plate, while, in the ordinary process of polychromatic printing, as many plates are employed as there are distinct colors. Ibid.

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### *Optical Solar Spectrum.*

M. Matthiessen presented a memoir, entitled "Memoir upon the optical solar spectrum; upon the improved lentiprism; upon the absorption of the new extreme violet by different substances; upon the elementary composition of the solar spectrum; and upon the structure of the eye. "I present," says the author, "drawings of the solar spectrum, as seen by my improved lentiprism, which is extended beyond the extreme red of the spectrum of Fraunhofer, and adds to it an extreme violet, equal to three-fourths of the whole optical spectrum hitherto known. This new violet part of the spectrum is covered by a great number of obscure rays remarkable, for the most part, for their regular disposition in groups." Not only do the instruments of M. Matthiessen increase the breadth of the spectrum beyond the photogenic impressions, hitherto obtained upon substances chemically sensitive, but they besides show groups of distinct rays, where the iodized plates produce only dark and shaded bands. Ibid.